JOURNAL

OF THE

BOARD OF AGRICULTURE

OF

BRITISH GUIANA.

VOL. XIV. JULY, 1921. No. 3.

TIMBER.

Reconstruction at home and a development of tropical resources abroad are to-day proceeding as a natural aftermath of the war.

Timber must necessarily play a large part in reconstruction of all kinds and as the more accessible sources of this all important commodity gradually fail to meet the ever increasing European demands, other and more distant areas will naturally be sought after.

The practical article in this number which comprises all of what is to-day known of British Guiana timbers—their accessibility, varieties and values, indicates that we are in a position to meet a vast demand for timber for a wide variety of purposes.

What development of this great source of wealth of ours has taken place?

Very occasionally an ocean going steamer or sailing barque penetrates up the Demerara or Essequebo River and removes a few thousand feet of greenheart and the local Carpenters find it cheaper to construct dwellings of imported pitch pine! Much firewood, shingles

and charcoal is shipped annually to Barbados and other West Indian Islands; in return are imported sweet potatoes and occasionally fruit, both of which might well be produced locally.

As Mr. Hohenkerk's contribution briefly indicates, a deal of knowledge remains to be acquired concerning our timbers and, further, their values must be made more widely known to the world in general before we can commence to look forward to a timber industry of any established magnitude.

AN ANNOUNCEMENT.

The following telegram was received from the Secretary of State for the Colonies by His Excellency the Governor, date June 2nd 1921 :—" It gives me much pleasure to inform you that His Majesty has been graciously pleased to approve of Knight Bachelor for Professor Harrison."

Thus the many achievements and distinctions won by Professor Harrison in the course of a long and arduous career wholly given to the interests of science and agriculture in the West Indies and British Guiana have been well and fittingly recognized.

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We feel both glad and proud of being able to take this opportunity, in a publication of which he was the founder some fourteen years ago, of offering our very sincere congratulations to Sir John and Lady Harrison.

FORESTRY IN BRITISH GUIANA.

An extract from the Statement prepared for the British Empire Forestry Conference by the Forestry Officer of B: Guiana.

AREA COVERED BY EXISTING FORESTS.

The forests of British Guiana are estimated to cover 78,680 square miles, or 87·9 per cent. of the total of 89,480 square miles. The easily accessible area of the Colony, is that portion lying between the coast and the rapids in the rivers, totals 18,500 square miles made up of the following areas: Forest land, 13,000 square miles; non-forested lands:—In cultivation 900, Muri or scrub 1,400, wet savannahs 1.200, and dry savannahs 2,000, making a total of 5,500 square miles.

The remaining area of the Colony from the rapids inland (with the exception of the Essequibo river lands above Rockstone Railway Terminus, which is being worked for Greenheart timber) totalling 70,980 square miles, is made up of forests— 64,780, and dry savannah (or grass) areas—6,200 square miles.

The lands alienated from the Crown equals 1,800 square miles, being 2 per cent. of the whole area or 10 per cent, of the accessible area of the Colony. Land under temporary cultivation by the aborigines, which, after producing one, or at most two crops, are allowed to again become afforested, are not included in these figures, but their aggregate area would not exceed 150 square miles.

Indian Reservations are those areas reserved from the Crown forests by the local Government for the use and benefit of aboriginal tribes, from which only limited quantities of timber and balata are produced by the Indians. All of these Reservations are situated in the easily accessible area: their total area of 1,360 square miles is included in the area of Crown Forests, viz., 12,100 square miles.

Table 1.—STATEMENT showing the Total Area of Forest and the Percentage of the Land Area covered by Forest.

—	Agricultural Land.	Forest. Merchantable. (Estimated.)	Forest. Unprofitable or Inaccessible.	Forest. Total.	Other Land. (Estimated.)	Total.
Sq. miles ...	900	13,000	64,780	78,680	*Accessible*— Muri or scrub 1,40 Wet Savannahs 1,200 Dry Savannahs 2,000 *Hinterland*— Dry Savannahs 6,200 10,800	89,480
Percentage of total area.	1	14.5	72·4	87·9	12·1	

OWNERSHIP OF FORESTS.

The Crown controls the whole of the forests of British Guiana with the exception of those on alienated or privately owned lands. These private lands are estimated to aggregate 1,800 sq. miles, of which about one-half is in forest and the other under cultivation.

Licences, renewable annually and a few issued for two or five years, are granted by the Crown for wood cutting; 402 of these, aggregating 575 sq. miles, are in existence, and this area is included in the area of Crown Forests.

FORESTRY ACTIVITIES OF COMPANIES AND PRIVATE INDIVIDUALS.

There are in existence 402 licences for cutting wood over the Crown Forests, aggregating in area 575 square miles, or about 3 per cent. of the easily accessible area of the Colony. These licences are issued for terms of one to five years, the majority being for the shorter period renewable annually. The titles are held by eight incorporated limited companies, four other companies, and by 138 individuals. Of this total number 36 tracts are for selective cutting of Greenheart only. The remaining tracts are for cutting small timber and fuel wood, and for producing shingles, staves and charcoal.

Some of the timber cutters, both companies and individuals, possess power mills for sawing logs, scantlings, and boards; 12 mills are situated in the country districts or up rivers, 3 in New Amsterdam, the chief town, and 7 in Georgetown, the capital, making a total of 22. Some of those in New Amsterdam and Georgetown have wood-working machines also in operation. The local Government own one saw-mill 65 miles up the Demerara river, worked by water-power, the timber for which is purchased at market price from natives or Indians.

Greenheart timber is hewn, alongside the stumps, into square logs, which are hauled and transported to the nearest shipping point. The haulage hitherto has been done by man power or oxen, and only in the last year or two has motor-tractor haulage been adopted by some of the larger operators. The logs, being heavier than water, are slung on each side of long, narrow, flat-bottomed punts, each carrying from two to six logs, and poled down the smaller streams to the rivers, where they are transferred to larger punts, which transport loads of 2,000 cubic feet or more to the loading ocean vessel or to the mills.

Shingles, staves, posts, fuel wood and charcoal are hauled in carts by mules or donkeys to the shipping points on streams navigable for large punts or lighters.

Annual Increment and Utilisation of Home-Grown Timber.

A.—*Increment.*

Unfortunately in this Colony forestry investigations and tree measurements have not progressed to the stage where estimates can be made of stands of timber, and this, coupled with the lack of accurate, or even approximate, topographical surveys, precludes the forming of

even rough estimates of the increment per square mile, or of losses through fire, waste, or decay, in Crown or privately-owned forests.

It is known that at periods of drought which occur about every ten years forest fires are numerous, and at certain times and places very destructive, so much so that instead of a stand of all kinds, from 18 inches girth upwards of about 140 to 160 trees per acre, there have been found in places only from 15 to 20. But the extremely rapid growth of tropical vegetation causes these places to be naturally reafforested with quick-growing soft wood trees in comparatively few years.

B.—*Utilisation.*

No records are available showing the amount of timber or forest products obtained from privately owned lands; Table IV therefore gives the quantities and values only from the Forests under State control, including timber, &c., cut by Aboriginal Indians.

During the previous five years 1909-1910 to 1913-1914, Greenheart timber obtained was 527,355 cubic feet, and British Guiana Mahogany 59,993 cubic feet, showing by comparison with the last five years, respectively, an increase and a decrease in the production of these two woods.

Local prices have risen considerably from pre-war years up to the present time, and there is no likelihood of any great drop in the near future. The table shows that the estimated value of timber produced averaged 313,065 dollars or £65,222, and including Forest products, the total production from the Crown Forests averaged 1,179,380 dollars or £245,704.

Table IV.—Annual Utilisation.

——	Type of Product.		Quantity.	Estimated value at place of preparation $.
A.—*Timber*— Under State control	Greenheart and mora, cut by Indians, average for 4 years, 1915-1919	cubic feet	6,338	1,315
	Greenheart average 5 years, 1915-1919	,, ,,	558,982	288,820
	Other hard woods, four years, 1916-1919	,, ,,	73,664	11,800
	B.G. mahogany, average 5 years, 1915-1919	,, ,,	53,030	6,900
	All other timber, average 4 years, 1916-1919	,, ,,	34,205	4,230
Other	Mora, other hard woods and soft woods	,, ,,	Unknown	Unknown
Total	... ...	...	...	$313,065 (£65,222
B.—*Forest Products*— Under State control	Vat and fencing staves, posts, &c., from Indians, average 4 years, 1916-1919	number	...	1,315
	Wallaba shingles, average 4 years, 1916-1919	,,	5,686,145	24,500
	Wallaba staves, ,, ,, ,,	,,	202,468	25,000
	Wallaba and other posts, average 4 years, 1916-1919	feet	350,752	5,500
	Wattles and sticks, average 4 years, 1916-1919	number	14,876	450
	Fuel wood, ,, ,,	tons	78,560	232,500
	Charcoal, ,, ,,	,,	4,556½	70,000
	Tanning bark, ,, ,,	lb.	83,335	400
	Balata, ,, ,,	,,	1,407,272	506,620
	Gum, ,, ,,	,,	327	30
Other	Shingles, staves, posts, wattles, fuel wood and charcoal		Unknown	Unknown
Total	... ...	...	...	$866,315 (£180,482)
Grand total value of timber and forest products from Crown forests			...	$1,179,380 (£245,704)

Forest Industries, Statistics of Volume of Timber, &c. Consumed, and of Value of Product and Number of Persons Employed in Main Forest Industries.

The timber cutters, charcoal burners, and other men working on a licensed woodcutting grant, and also the foreman and bleeders on a tract licensed for balata production have, by law, to be registered.

Table V gives the consumption of timber and wood products, and the men registered during the past five years for such work. In the previous four pre-war years the numbers of men registered for work on timber and balata grants were, respectively, 1,389 and 3,764.

Table V.—Forest Industries.

Industry.	Estimated Volume of Timber consumed.			Estimated value of Product at Place of Preparation.	Number of Persons employed.
				Dollars.	
Timber ...	Greenheart ...	cubic feet	460,400	237,883	Average for five years, 1915-1919 registered men 2,977
	All other timber	,,	23,070	3,290	
Principal wood products	Shingles ...	No.	2,765,283	11,915	
	Fuel wood ...	tons	70,615	208,986	
	Charcoal ...	,,	2,026	31,125	
	Also staves, posts and other articles.				
Balata ...	Nil (all exported)			...	3,594

Summary and Outlook.

A.—*The Total Home Consumption of Home-Grown and Imported Timber.*

The figures given below in Table VII are averaged for the last five years and, as already stated, represent timber only from Crown forests.

The average amounts of the principal wood products for the last four years are as follows:—

Type of Product.		Utilization.	Exports.	Home Consumption of Home-grown Product.
Shingles ...	No.	5,686,145	2,920,862	2,765,283
Fuel wood ...	Tons	78,560	7,945	70,615
Charcoal ...	"	4,556	2,530	2,026

The factor which appears to operate against the larger use of local wood is that the imported lumber has been more or less seasoned, and is fit for use at the time of purchase, whereas there is no artificial or other seasoning of local timber before it is milled. In consequence of this the imported lumber amounts to over 200 per cent. of the home-grown lumber used.

TABLE VII.

Type of Product.	Utilisation.	Exports.	Home Consumption of Home-grown Timber.	Imports.	Total Home Consumption of Home and Imported Timber.	Net Increment.	Balance
Timber ...	Average 5 years Cub. feet	Average 5 years Cub. feet	Cub. feet	Cub. feet			
Greenheart ...	560,000	99,600	460,400	Pine lumber,			
All other timber ...	166,220	23,070	143,150	337,720			
Total ...	726,220	122,670	603,550	337,720	941.270	Unknown.	Unknown.

B.—***Probable Duration of supplies at Normal Rates of Cutting and of Growth.***

Unknown.

C.—*Short Summary of Steps which should be taken to Protect and Develop the Forest Resources of the Country.*

For the proper protection of the forests of this Colony a greatly enlarged knowledge of the habits of growth and rate of annual increment of the various species is required. It would be necessary to inspect carefully and in detail forests now being cut and already cut over both recently and many years ago, together with the adjacent virgin forests, in order to comprehend the process of natural re-afforestation in the tropics, the percentage of different species during the various stages of this second growth, and to obtain some idea of the rate of such growth.

In Greenheart forests the cutting of timber is purely selective, and frequent inspections during the working of the tracts are necessary to compel the utilisation of marketable timber, *e.g.*, upper parts of stems and the branches, and thus prevent the present lamentable waste. Should clear-felling be adopted it will be necessary to compel cutters to leave a proportion of parent trees of the more valuable species on every acre cleared, and it will also be necessary to control cutting in order to prevent the clearing of excessively large areas with the consequent interference of climatic conditions.

Investigation of burnt areas in easily accessible districts should be made during the progress of the fire or shortly after, in order, if possible, to determine the origin and area of destruction. The natives and forest workers should be warned both by written and spoken word of the careless use of fires in the forest during the dry seasons; and the present practice of burning off grass areas or fields cleared for cultivation should be prohibited except under the control of a forest officer or ranger.

This would require material enlargement of the Forestry Staff, which now consists of only one officer, seven rangers, and one native assistant for botanical and other work.

To develop the forest resources roads or railways are required, traversing the easily accessible districts and extending into the mountainous country beyond; clear-felling down to marketable sizes of all species should be adopted; modern methods of haulage and transport are required; saw-mills of modern type should be erected on navigable rivers, as near the site of cutting operations as possible, each of which should have a kiln for artificially seasoning timber; wood-working machinery for making tool handles and other articles; a chemical and physical laboratory for testing latices, gums and saps for dyes, medicinal and other properties, and to ascertain the suitability of woods for manufacturing paper pulp, wood alcohol, acetone, &c., advertising the timber possibilities of the country in order to reach prospective investors.

THE IMPERIAL ENTOMOLOGICAL CONFERENCE—(*Contd.*)

Thursday, June 3rd.

In the Chair—Professor E. B. Poulton, F.R.S.

Discussion: "The Education of Economic Entomologists."

Professor H. Maxwell Lefroy read a highly interesting paper on "The Education of Economic Entomologists." Prof. Lefroy's paper bore considerable weight as he has wide experience in such work.

Dr. R. J. Tillyard (Australia) agreed with many of the points made by Prof. Lefroy and emphasized the necessity of a University Natural Science Course as the basis for an Economic Entomologist's training.

Dr. L. O. Howard (U.S.) gave short details of the kind of training that economic entomologists received in the States. He agreed that training in agriculture was also necessary

Dr. R. Stewart MacDougall (Edinburgh) remarked that the study of Botany was also necessary. Every student at Edinburgh had a chance of becoming an economic entomologist.

Mr. H. A. Ballou (Barbados) also emphasized the necessity of a broad training in agriculture as part of the equipment of a competent entomologist. Other subjects such as plant physiology and mycology were necessary if the entomologist was at all likely to have to work alone.

After a number of other Delegates had spoken the Chairman, in an able summing up of the discussion, remarked that it was the man and not the system that counts.

The meeting was brought to a close by a Resolution which was carried with considerable enthusiasm, to the effect that "This Conference expresses to the United States Government, through Dr. Howard, thanks for the generous way in which they had distributed their valuable publications.

Afternoon.

A staff Conversazione was held at the Natural History Museum, South Kensington.

Some interesting exhibits were on view illustrative of some of the phases of work performed by the staff of the museum during the war,

An enjoyable afternoon was spent; the proceedings terminated with an official photograph of the delegates.

Friday, June 4th.

Visit to Rothamsted—This famous experimental station, which was founded as far back as 1843, proved of very considerable interest. The various experimental plots were ably demonstrated including those on the well known Broadbalk field. Later in the day an interesting discussion was held on "Tropisms and their Interpretation" which was opened by Dr. A. D. Imms of the Entomological Department of the Station. The various investigations in the laboratories were demonstrated and proved of absorbing interest.

The writer, who had previously visited Rothamsted in 1909 and 1910, whilst an agricultural student at Cambridge University, was particularly interested in the great developments that have taken place.

Monday, June 7th.

In the Chair: SIR DANIEL MORRIS, K.C.M.G.

Discussion: "Resistance of Plants to Insect Attacks."

Mr. H. A. Ballou (Barbados) in an interesting paper opened the discussion. The substance of his remarks was that it is not merely the case that unhealthy plants encourage insect attack but that healthy plants appear frequently to possess some quality that operated as an actual deterrent.

Mr. F. A. Stockdale (Ceylon) gave a number of instances of insect attack on both healthy and unhealthy plants. He concluded by drawing attention to the necessity for carefully dealing with agricultural conditions in combating insect pests.

Dr. R. J. Tillyard (New Zealand) referred to the resistance of apple to wooly Aphis.

Mr. C. F. C. Beeson (India) stated that in India, forest borer epidemics always followed some primary cause such as forest fires, bad soil aeration, etc. He thought that ultimately insect control will be effected by agricultural methods.

Mr. F. W. Urich (Trinidad) said that in Trinidad thrips attack all cacao trees whether in good or bad condition.

Prof. H. M. Lefroy pointed out that there was a distinction in immunity from biting and from sucking insects.

Mr. C. P. Lounsbury (South Africa) stated that many of the South African scale-insects thrive best on the best cultivated trees.

Mr. H. A. Ballou in closing the discussion remarked that there was a good deal of recognition of his contention in all the remarks made. He was certain that agricultural methods influenced infestation.

Afternoon.

Mr. G. E. Bodkin (British Guiana) read his paper on the insect pests of that Colony. The paper was illustrated with numerous lantern slides.

Mr. F. W. Urich (Trinidad) followed with a paper on the Insect Pests of Trinidad.

Mr. H. A. Ballou (Barbados) then read a paper entitled "Review of the conditions in the West Indies in regard to agriculture and crop pests."

Tuesday, June 8th.

Visit to Oxford—An interesting time was spent here principally in the Hope Museum with Professor E. B. Poulton, F.R.S. The magnificent collections were inspected also those formed by Prof. Poulton illustrative of the many phases of mimicry. The writer was much interested in several large collections of British Guiana butterflies.

Interest was also aroused in the immense larva of a West African Lasiocampid moth which dwarfed any such form even in this country of entomological wonders: many of the scientific laboratories, some of comparatively recent origin, were viewed.

The day terminated with a tour of the various colleges.

Wednesday, June 9th.

In the Chair: Professor R. NEWSTEAD, F.R.S.

Discussion: "Artificial *versus* Natural Methods of Control of Insect Pests."

Dr. F. W. Urich (Trinidad) stated the case by illustrations from the frog-hopper problem in Trinidad. He detailed the various artificial methods that had been attempted. Dusting with the green muscardive fungus had given satisfactory results. In conclusion he remarked that much good resulted from agricultural methods such as forking, weeding and draining.

Mr. R. J. Tillyard (New Zealand) gave instances of natural *versus* artificial control in New Zealand.

Mr. Balfour Browne (Queensland) did not agree with the importation of natural enemies into a country to control a pest therein. Such importations had been known to do more harm than good. He cited instances thereof.

Mr. H. H. King (Sudan) believed that most agricultural pests could be controlled by cultural methods. This entailed a knowledge of the correct method and cooperation between the growers.

After a number of the delegates had spoken the Chairman summed up by stating that the introduction of natural enemies was advisable, care, however, should be used in their selection so that crops should not be endangered.

Afternoon.

Dr. R. Stewart MacDougall read his paper "Insects in relation to afforestation" illustrated by slides.

Mr. F. A. Stockdale (Ceylon) read his paper on "Insect Pests of Tea in Ceylon."

Thursday, June 10th.

Visit to Cambridge—A valuable time was spent with Prof. Nuttall, F.R.S., Quick Professor of Biology in the University of Cambridge. The entomological work carried on in the school of Agriculture was inspected, also the collections in the Cambridge University Museum.

The Conference terminated with a dinner at Lancaster House on Friday, June 11th.

A toast "The Delegates to the Imperial Entomological Conference" was made by the Right Honourable the Viscount Milner G.C.B., G.C.M.G.

Prof. R. D. Watt (Australia) responded

Imperial Entomological Conference.

The following resolutions were unanimously adopted by the Conference on the 11th of June :—

(1) In the opinion of this Conference it is most desirable that similar Conferences should be held in London once in five years.

(2) This Conference would view with dismay the possibility that the Imperial Bureau of Entomology should, through lack of funds, cease or in any way curtail its present work, and recommends most strongly that steps be taken to establish the Bureau on a permanent basis.

(3) In order to place the Bureau on a sound financial basis, this Conference recommends that all the contributing Governments should be urged to guarantee their contributions, subject to the proviso that any Government be at liberty to raise through its representative at quinquennial Conferences the question of modifying the amount.

(4) This Conference recognising that the funds now contributed for the upkeep of the Bureau are quite inadequate, recommends that the annual contributions should be increased so as to provide a total income of not less than £13,000 per annum in order to allow for the necessary staff to carry on work on existing lines.

(5) This Conference accepts the recommendation of the Special Committee that the Secretary of State for the Colonies be requested to establish a Provident Fund for the staff of the Bureau in lieu of pension rights.

(6) This Conference agrees that full power should be left to the Director and Managing Committee of the Bureau to exercise their discretion as to the General scope and contents of the Publications of the Bureau and the expenditure involved thereby.

(7) This Conference agrees that the appointment of a Coccidologist to the Staff of the Bureau is unnecessary but considers that the Director should encourage members of his staff to pay special attention to particular groups, especially to those for the identification of which no specialist is available.

(8) This Conference considers that the provision of an adequate number of trained men to carry into effect existing plant import legislation is of more immediate importance than the revision or extension of such legislation.

(9) This Conference accepts the report of the Sub-Committee on the Convention prepared at the International Conference on Phytopathology held at Rome in March, 1914.

(10) The Delegates to this Conference desire to express their sincere thanks to the Chairman, Viscount Harcourt, the Honorary Committee of Management, the Director and the Assistant Director of the Imperial Bureau, for the excellent programme drawn up and carried out by them, and also to Professor Poulton and Dr. Dixey, of Oxford University, Sir Arthur Shipley and Dr. Hugh Scott, of Cambridge University, Dr. Russell and Dr. Imms of the Rothamsted Experimental Station, for the enjoyable and instructive visits arranged by them.

REMARKS ON OUR MILK SUPPLY.

By Mr. G. Grant.

We have reproduced this paper from the Proceedings of the Agricultural Society of Trinidad and Tobago as it contains a number of points of interest to our local dairymen.—Editor.

I have classified them under the following headings:

1.—Breeding.
2.—Feeding.
3.—Diseases.
4.—Milking Methods.
5.—Education.
6.—Goat Raising.

BREEDING.—This is where the greatest fault lies. Very seldom is any selection done, the cow being sent to the nearest bull. Good bulls of milking strain are few and far between in Trinidad, but this is a matter which can be remedied either by Government help or through Community Breeding.

As far as breeds are concerned it would seem proved that pure breds from Northern climates do not thrive with us. The Zebu has proved that it can stand our climate well, and is a decided improvement on the local stock. A type that seems to give best results is either the pure bred *Zebu of a milking strain* or a cross between the Zebu and good Dual Purpose Northern stock, such as the Red Poll. The water Buffalo often called "Hog Cattle" also claim attention and are strongly advocated by some as the animal for the country to adopt. Most authorities agree that the Zebu with its high resistance to sun, ticks, and Strongylus should form the greatest factor in improving our stock, either by crossing with our native animals or preferably with high producing Northern cattle.

FEEDING.—This is a point that too few pay attention to. An animal needs a certain amount of food to keep itself thriving, and the rest of the food it digests goes either to form fat or milk, depending on the cow. Concentrates or food rich in protein chiefly; not only keep the cow in better condition and lead to better yields, but often tend to lengthen the milking period. Numerous experiments have been carried out to determine whether the quality of the food has any influence on the percentage of fat in the milk but they all show that where there is any influence it is only for a few days at the most, and that after that time the milk goes back to normal. In exceptional instances there has been a slight difference, but this seems to be due to the very sudden change in the ration of the animal, and when we consider the nervous disposition of the cow we can readily see how this came about. Oilmeal and other concentrates can in the writer's opinion, be used more than at present with paying results.

DISEASES AND PESTS.—The chief disease is Strongylus, caused by an intestinal parasite very similar to that causing hook-worm in man, Some authorities claim that it is present in 90% of our stock. Very few of the smaller cattle owners seem to know of its existence or of the harm it does to their stock, and certainly very few know what to do to keep it in check. It seems to be

a case where a programme of education is advisable, or rather, distinctly necessary. The following methods of control have given good results ;—

1.—Pasturing animals after the dew is off the grass. It has been found that the parasite stays at the tips of the blades of grass as long as there is dew on them, but when these dry it goes down to the roots and into the ground to get at the moisture there.

2.—Spraying pastures first with salt and after with lime. Soot is used in some countries but is not obtainable here to any extent.

3. The use of some of the best Worm and Condition Powders on the market. Turpentine is also recommended.

4.—Fumigation with sulphur. This should be used only as a last resort as it sometimes proves fatal.

TICKS.—The presence of ticks is making itself more and more felt, and this is only natural as no concerted effort has as yet been made to keep the tick from spreading. Ticks not only cause loss of blood, damage to hides, general debility, etc., but in some cases are the spreaders of some of our worst stock diseases.

Experiments conducted by the U S. Dept. of Agriculture have shown that the yield of milk is appreciably reduced when ticks are allowed on cattle. The remedy is simple. Spraying with some effective dip should be made compulsory.

MILKING METHODS.—The usual method is to allow the calf to suck both before and after milking. This lowers the percentage of fat in the milk, usually caused digestive troubles in the calf, due to the excess of fat in the "strippings" or last drawn milk which the calf receives, and often is the cause of the short milking periods so common in our cows. Wherever possible more similiarity in length between periods of milking would be better.

EDUCATION.—I consider this to be essential if we are to expect any considerable improvement in our milk supply. The greater percentage of cattle raisers here are more or less uneducated and it will be hard to get them to change any of their ideas, but they are the ones through whom we can make the most improvement in our milk supply. This may be done through the different agricultural societies, especially if the members would interest themselves in the matter. Especially is education necessary as regards Breeding, Treatment of the common diseases, and Milking Methods.

GOAT RAISING.—The keeping of goats would be a great help in increasing the milk supply of the island. Many more people could keep them than are now doing so. Goats are easily reared give better returns for feed than do cattle and the milk is free from tuberculosis, again the milking qualities in goats can be more quickly raised than with cows. As with cows, pure-breds do not thrive so well as half-breds, and the best results will be got by crossing Toggenburg or Sinaan rams on natives ewes. Service stations could be established in different parts of the island, e.g. The St. Clair Experimental Station, Government Farm, etc.

Notes on Government Standard.

We have evidence showing that tropical animals give at least as high a percentage of fat as do those in more temperate regions. I do not think therefore that the present standard of 3 % fat should be lowered when we consider that it is already relatively low, e.g. the standard in Canada and in most of the States is 3.5 per cent.

Poor milk may be said to be due to three reasons:

1.—Watering or Skimming—Either of these merit severe punishment.

2.—Improper methods of milking—By allowing the calf to suckle it gets the richest portion of the milk, what is left for sale being of an inferior quality. Proper education would remedy this difficulty.

3.—Poor Cattle.—Very few cattle should give milk testing below 3 per cent. fat. These should be got rid of, or the milk kept solely for home use or stock feed. The per cent. of fat can readily be increased in the progeny of such an animal if it is bred to a bull of a high fat-content strain.

To avoid all suspicion on the part of the milk vendor I would suggest that it be made compulsory for a constable to take three samples of any suspected milk; one of these to be left with the vendor, one with some responsible person, and the other to be kept by the constable himself. All must be properly sealed and kept so as to settle any dispute that may arise later on.

SOME INTERESTING PLANTS.

By J. F. Waby.

Adansonia digitata, "Baobab," "Ethiopian Gourd," "Pain de Singe," "Monkey Bread," "Gorakimli," "Gourrik Chinty," "Salo," from Northern Africa, Ethiopia, supposed to be the largest tree in the world. It is a most peculiar tree in some respects not unlike the mighty "Ceiba" or large "Silk Cotton tree" of the West Indies, particularly as it is seen growing in Barbados; there it forms immensely tall trees with gouty stem, tapering gradually in its full height. In the Botanic Gardens, British Guiana, there are no large trees of this species, what few plants there are they are comparatively young as the Gardens did not exist before 1879. These plants have not yet produced flowers, but they follow the general form of the tree,—an exceedingly gouty stem with stout brittle branches. The one large conspicuous tree in Trinidad, in the entourage of the Queen's Park, almost opposite the Princes Building, is a typical specimen, though rather short, measuring at the ground-line 9 ft. in diameter, and 5 ft. 6 in. at 6 ft. above, tapering rapidly

upwards; the branches are stout and rigid, covering a space of 25 ft. on either side. It is deciduous. The foliage is compound, palmate, digitate, of 5 or 6—generally 6 leaflets, almost sassile, radiating from the top of the petiole which is 4—5 inches long, stout, leaflets entire, oblong, 3—4 inches long, 17/8—2 inches wide, dark green above, pale beneath. Midrib pronounced, veins regular close together. The foliage is borne in terminal crowns of 7 or 8 leaves. The infloresccnse terminal, solitary, by the side of the crown of foliage, pendant on a stout green peduncle 16—17 inches long, varying in thickness from $\frac{1}{4}$ inch at top to $\frac{1}{2}$ inch at base. The unopened flower is a conspicuous, slightly ribbed, pointed green cone at the end of the peduncle, $2\frac{1}{2}$—3 inches diameter, which breaks open at the point into 5 segments, this the calyx at least $\frac{1}{8}$ inch thick, which folds backwards to within an inch of the centre. The corolla is formed of fine thick waxen white petals overlapping each other and curving backwards and crimping 3 inches long and wide, these with age turn rusty brown. A white column occurs below the corolla $1\frac{1}{4}$ inches long, and $\frac{3}{4}$ inch thick, at the base of which is a ball of innumerable white filaments with small brown anthers, $2\frac{1}{2}$ inches in diameter. The female organ springs from the base to the ball of filaments; a hollow white funnel-like tube turned upwards 3 inches long, $\frac{1}{8}$—$\frac{3}{16}$ inch thick, the end opening flattened, bifid, $\frac{3}{8}$ inch across each half with several incisions $\frac{1}{8}$ inch deep, brown. The infloresscense is in every respect peculiar in its formation and always attracts attention as there is scarcely another similar. There was but one fruit produced and this disappeared without my knowledge.

Aniba megacarpa, "Laurier matae," a timber tree of Trinidad, 60 feet or more high. The branches are strong and in lateral spread in tiers. The foliage is in small groups on small branches in tiers, the latter slate-coloured The leaves 6—7 inches long, (petiole short) 2—$2\frac{1}{2}$ inches wide, stiff, coriaceous, dark green above, pale yellowish; beneath, entire midrib plain, yellowish veins regular, obliquely across. The infloresccnse terminal in axils, paniculate flowers very small unisexual. It bears a dark

brown coarse woody cupula, urn-shaped, 2 inches diameter and high, with coarse crenations on the top; a cavity $1\frac{1}{8}$ inches across the top and $1\frac{1}{8}$ inches deep, in which is fitted a spherical fruit, $3\frac{1}{4}$ inches long, one inch diameter, bluntly pointed, smooth, slightly furrowed, purplish black. The fruit drops out as soon as ripe and the cupula soon falls afterwards. The skin of the fruit peels off dry, leaving a spherical, polished brown hard shell nut, 2 inches long, and $\frac{3}{4}$ inch in the middle. It is not known if the nuts are edible.

Omphalea magacarpa, "Huntsman's nut" of Trinidad. A strong climber, reaching up into the largest trees enveloping the principal branches. The foliage fairly heavy in groups, and apparently deciduous, leaves alternate, oblong, pointed, cordate at base, entire, 8 inches long, $3\frac{1}{2}$ inches wide, glabrous, dark green above, pale beneath, smooth, edges slightly curved backwards; midrib and main veins prominent beneath, the latter widely distant, cross veins thin anastamosing closely between. Petioles 2—3 inches long, fairly thick. inflorescense terminal, paniculate, unisexual; flowers very small in the axils, a linear bract an inch long at each axil. The fruit globular pointed, 3 inches diameter, with 3 slightly raised ridges ending in a short nipple. It turns yellow on ripening with a rather soft thick skin and falls to the ground, bursting on impact, by the ridges into 3 equal portions of a very thick mealy substance tightly enveloping 6 large brownish nuts, closely and shortly muricate, rounded triangular, flat on the inner side, round at the back, $1\frac{1}{2}$ inches wide, $1\frac{5}{8}$ inches long, $\frac{7}{8}$ inch thick; the shell of the nut quite hard $\frac{1}{16}$ inch thick, white lined, with a clear-white kernel $1\frac{1}{8}$ inches diameter, $\frac{3}{4}$ inch thick, which is said to be intensely purgative.

Warzewiezia coccinea, "Chaconier" of Trinidad. A tall-growing, slender woody branching tree on the hill-sides and in the valleys, looking like a strong-growing climber. A beautiful sight of yellow and scarlet, the latter predominating. The foliage in pairs, large, oblong-spathulate entire, 12 inches or more long, 4—5 inches wide, dark green; midrib conspicuously pale green, veins regular and straight across, $\frac{5}{16}$—$\frac{1}{2}$ inch apart, prominent

below; petiole 1 inch long, inflorescense terminal, 12—18 inches long; flowers small, yellow, in short fascicles in pairs, $\frac{3}{4}$—1 inch apart, one or two scarlet bracts to each fascicle, the petiole ot these slender, an inch long, the blade oblong, 2—2$\frac{1}{2}$ inches long, 1—1$\frac{3}{4}$ inches wide, pointed, several straight veins running from the base; the bracts lying over on each side making the inflorescense very conspicuous. The fruit a mass of small green knobs at each fascicle.

Napoleona imperialis, "Napoleon's star" of Sierra Leone. A rather scrambling hard-wooded large shrub. The foliage dark green, entire, oblong, pointed, 5-7 inches long, 2-2$\frac{1}{2}$ inches wide. Flowers solitary, sessile, generally on the naked branch, sometimes amongst the end leaves. A peculiarly beautiful object with a rather fœtid odour. The base of the flower is like a 5 pointed star 1$\frac{3}{4}$ inches across, fixed to the centre and edging it all round $\frac{5}{8}$ inches wide, of a peculiar dark chocolate colour, edged with deep orange, fluted and toothed all round. Above this is a fringe of white filaments $\frac{3}{16}$ inch long. The centre of the flower is like a button $\frac{5}{8}$ inch across, curved inwards in close sections,—these are the stamens arching to the pistil in the centre, which is a dark red mass. Outside this button of stamens is a crêpe-like frill nearly $\frac{1}{4}$ inch wide, cream coloured, deeply knotched, the points a dark red, with a bright red circle underneath close to the fringe of filaments. Below this is a green calyx of 5 sepals an inch across. No fruit has been seen.

Adhatoda cydoniaefolia, a large spreading handsome shrub from Brazil, 5-6 feet or more high, and spreading as much, very floriferous, wood brittle, square jointed 3-4 inches apart. The foliage 12-14 inches long, 5-6$\frac{1}{2}$ wide, entire, oblong, pointed, of an ordinary green, veins regular and plainly marked. The inflorescense a terminal pyramidal panicle 15 inches long, bracts in pairs or double pairs on alternate sides 6 inches long; the beauty of the inflorescense is that of the bracts which are of a bright purple colour, set 3 together 1 large and 2 small, the large

2 inches long by $1\frac{1}{4}$ inches wide, the small ones 1 inch long by $\frac{1}{2}$ inch wide; the flowers, white tinged with pink, spring from between the bracts, $2\frac{1}{2}$ inches long, the tube $1\frac{1}{2}$ inches, narrow; the 2 stamens and pistil nestling in the hollow, with a curved portion in front as long as the tube but rather wider. The calyx 5 pointed $\frac{5}{8}$ inch long, pinkish. The fruit a thickish spathulate capsule, an inch long, $\frac{5}{16}$ inch wide at the widest end, dehiscing sharply, exposing 2 or more flat seeds $\frac{1}{4}$ inch across.

AGRICULTURAL NOTES.

POULTRY NOTES.

HOW TO IMPROVE BREEDING STOCKS.

Inasmuch as the average farmer does not keep poultry as his main business the problem for him to solve is how to improve his flock at least cost. There are three methods of procedure: (1) To buy a setting of eggs, (2) to buy a few hens and a cock, and (3) to buy a cock only. To buy a setting of eggs is usually the cheapest method. However, as eggs from very choice flocks are expensive the cost may be high, unless all the eggs hatch and no loss among the chicks is experienced. To buy a few 6-months-old pullets and a cock is a perfectly satisfactory but rather expensive method. Birds from highly developed strains are always expensive, but it is wiser to pay a high price for a few select birds than to buy a larger number that will prove undesirable. The same rule applies when buying a cock only. Such a bird, if obtained from a conscientious breeder, may be cheap at $25, and if an individual can not afford to buy it a community or a poultry club may do so. A choice male when mated with a flock of 20 hens, selected from the very best obtainable in the neighbourhood, will upgrade the stock in a very short time.

What breed to choose is so much of an individual question that it is difficult to give advice about selection. Undoubtedly on a poultry farm the most profitable bird is one of the egg breeds, since these are small and produce a large number of eggs in comparison with the little feed they consume. Feed is quite expensive in Porto Rico, and it pays to sell 9 eggs (1 pound) for 45 cents rather than live poultry at that price. On the average farm the heavier general-purpose breeds may be profitable, but even there the feed is by no means cheap. Moreover, the consumers are used to paying for poultry by the piece and not by weight. For this reason it will be more difficult, at least for some years, to sell the larger birds to good advantage.

As a rule the most practical method of improving the farm flock is to buy a purebred cock of a selected strain of one of the egg breeds and to mate him with 15 to 20 hens selected from the best native stock obtainable. Eggs from those hens should be the only ones allowed to hatch, and from the progeny the most desirable hens should be selected. These hens should be mated with a fresh purebred cock, or exchanged with another poultry club. The principal fact to be borne in mind is that a purebred selected male should always be used, but never one that is either father or brother to the hens.

How to select Breeders.

As egg production is at present more profitable than meat production, the directions here given for selection of breeding stock are intended to enable the poultry raiser to secure the largest possible number of eggs from the hens of his flock. Selection is absolutely necessary regardless of the breed. Any strain quickly deteriorates without rigorous selection.

The Egg Type.

The egg type is generally characterised by its long, graceful body. From the side, the neck and tail appear to be placed at an angle of 45° to the body. The back is long and straight. The breast is evenly curved from the head

to the legs. The general appearance is graceful, never heavy or dumpy. The vigorous bird of any breed, and not the small, inactive one, should be selected.

HEAVY EATERS.

A hen of good egg type will produce eggs sufficient to pay for the feed she consumes; she must, however be a hearty eater, else she will not produce the maximum number of eggs. A hen may be compared with a machine used for manufacturing eggs. She is fed well, and in return is expected to be capable of giving the largest number possible of eggs.

EARLY RISERS AND LATE RETIRERS.

In order to observe these points, one must "get up in the morning with the chickens." To know the worth of hens which are to be used for breeding purposes the caretaker or poultry manager must know all about them. Hens which go to roost early in the evening and stay until late in the morning are not desirable types. The hen that fills the egg basket is the early riser and late retirer.

HEAVY PRODUCERS.

Production is the real test. A hen may be of the egg type, she may be large and vigorous, she may be a heavy eater and an early riser, and yet she may not fill the egg basket. Where there are large flocks of chickens it is impossible to determine the individual production of eggs unless one uses trap nests. On the farm, however, it is not an uncommon thing for the housewife and the children to know what the hens are doing.

PERSISTENT LAYERS.

The good egg producer is the hen that lays persistently and frequently. The hen that has frequent or long-continued non-laying periods is not the one producing 200 eggs a year. There are hens which produce as high as 300 eggs a year. Inasmuch as a hen can not produce eggs and feathers at the same time, it is reasonable to conclude that the heavy producer has a short molting season; or, in other words, she starts to lay early in the season and keeps on until late. The hen producing eggs when eggs are high in price is, of course, the most profitable.

Mature Birds.

Mature birds are the only ones from which to select. Pullet eggs should never be used for hatching. The value of a hen can not be determined until she has been under observation for a long time. A pullet hatched early in the spring should begin to lay eggs in the fall. In that case she can be carefully watched until the next fall, when she begins to molt, and the spring after that, when she begins to lay again. If she ranks high in all the points discussed above, it is quite certain that her eggs will be superior to the average for setting. A keeper should not be discouraged if he finds but one hen in a whole flock, or even in a whole community, that grades high in all or most of the points mentioned. By hatching a few dozen eggs from that particular hen mated to a purebred cock, tha keeper may expect in a few years a strain of chickens that will produce many more eggs than he now gets.

The Male Bird.

The male bird should also be selected, whether it is purebred or mongrel. While it does not pay to use a mongrel male for breeding, this bird should, if used, be selected for egg type characteristics, the same as the hen. Under no consideration should a cock be used for breeding unless hatched from an egg laid by a selected hen. Where the flock is large an extra cock may be kept as a reserve, but otherwise all cockerels should be disposed of in the fall. It is a financial loss to keep them longer, as they have no influence upon the hens in regard to the number of eggs produced. The hens will lay as many eggs without the males, and the eggs will be of better keeping quality. The latter is of greater importance in Porto Rico than is generally realized. Eggs that are not fertilized will keep fresh for several weeks if kept in a clean, dry, and moderately cool place. Unfertilized eggs will also keep much longer than the fertile ones when a preservative is used.

Keep Young Birds Only.

A pullet hatched in April will usually begin to lay in November and continue laying through the winter. Next

fall she will go through her first molt, and begin laying again sometime during the winter. The following fall—that is, when she is 2½ years old—she should be disposed of. Many poultry keepers in the States dispose of the hens the second fall; that is, when they are 1½ years old. This, however, is not practicable on the farm. On the other hand, it is unprofitable to keep hens after they attain the age of 2½ years. That rule does not apply to breeders of course. They are frequently not selected until in the third year, and they may be kept for several years if their progeny is satisfactory.

Sanitation.

On the farm sanitation means ordinary cleanliness; that is, clean drinking water, clean roosting places, and clean nest boxes. The roosting places should be cleaned and thoroughly whitewashed with lime every month. The nest boxes should be cleaned and the contents burned. It is good practice to hold the box over a fire so as to scorch the inside and thus kill germs and insects. In Porto Rico, where tobacco stems and waste from tobacco factories can be obtained cheaply everywhere, there is no reason for letting the poultry suffer from insects. Tobacco stems should be substituted for straw in the nest boxes, and tobacco dust should prove as good an insect powder as can be bought anywhere. Nothing is better than grease containing a few drops of kerosene to drive fleas from the heads of chickens. Carbolineum, or crude petroleum, thoroughly applied to the roosts, the interior of the chicken houses, and to the nest boxes, is an effective treatment for mites and ticks.

In the commercial poultry yard sanitation is the all-important problem. Undoubtedly most of the failures in Porto Rico can be traced directly to improper sanitation. The temptation seems to be to keep too many birds in one inclosure, or in several adjoining inclosures. This is a very dangerous and an unwise practice unless conditions are favourable and great precautions are taken. In the first place, the yard should be well drained, and the land made to slope so that the water will run off quickly. The

fence should be of wire, not boards and the fence posts should be of cement. The house should preferably be constructed of cement posts, with cement floors and galvanized-iron roofing. In addition, the house and yard should be shaded by rather large trees. Where several pens are close together they should be so located that water from one can not drain into another.

All pens must be carefully cleaned every week. The manure should be swept up and removed. The posts, roosts, etc., should be sprayed with a lime whitewash, and the ground should be well sprinkled with powdered lime. A sick bird should be promptly removed to an isolated pen, and a dead one should be immediately burned. In case of an epidemic the birds should be removed, each pen separately, to some new location, and their old pens should be disinfected with crude carbolic acid or some other strong disinfectant.

—*Porto Rico Experiment Station. Circular 19.*

LOSS OF CITRIC ACID IN LIMES AND LIME JUICE.

During his recent visit to Dominica, Mr. S. M. Davis Chief Chemist to Messrs. Rowntree & Co., the Cocoa Manufacturers of York, found an opportunity to make certain investigations concerning the loss of citric acid which may occur in lime and in lime juice under certain conditions; he has placed these observations at the disposal of this Journal in the hope that they may be of interest to lime growers in Dominica and elsewhere.

(1) *Loss of Citric Acid in Rotten Fruit.*— Sets of fifty limes of various degrees of ripeness were hand pressed, the juice from each set measured, and its acidity determined. This gave data for calculating appoximately, the weight of acid that a barrel of each type of fruit would yield.

Thus—Ripe yellow limes yielded		5·3lb citric acid per barrel.
Yellow green limes ...	...	4.9 „ „ „
Overripe limes ...	...	4·6 „ „ „
Green limes ...	...	4·4 „ „ „
Mushy, rotten limes...	...	1.7 „ „ „

It may be noted that yellow green limes give the clearest and most acid juice, but a smaller content than fully ripe ones. The overripe limes gave, of course, a thick juice, and the mushy, rotten, limes, a pulp from which it was difficult to strain even a thick juice. Note the enormous destruction of citric acid that takes place: fully two thirds of the original content has disappeared.

(2) *Losses of Citric Acid on Storing Lime Juice.*—Two hundred pounds of second roller juice, fresh from the rolls was run into a half tub, to a depth of 11 or 12 inches. It was allowed to stand under cover with no disturbance of the scum, except that caused by continually lifting the tub on to a platform scale, from time to time, to determine the loss of weight by evaporation. At the same time the acidity of the juice was determined.

The experiment had to be discontinued on the nineteenth day. During this time, the 200lb of juice was reduced to 184lb by evaporation, and the original acidity of 12·1oz. to 11·3oz, equivalent to 10·4oz, on the original volume. Thus a loss was recorded of 1 7oz citric acid per gallon in nineteen days, representing 14 per cent. of the original acid content.

In addition to the scum of pectous matter and essential oil, the usual thick skin of *Sacch. mycoderma* formed on the surface. Under the microscope a lively growth of mycoderma was seen to be accompanied by a considerable growth of bacteria. The action of mycoderma on citric acid, as is well known, results in its eventual decomposition into carbon dioxide and water. Bubbles of the gas formed freely under the skin and broke at the surface of the juice.

Under the conditions described it seems therefore safe to say that during the first few weeks of storage, the loss of citric acid is of the order of five per cent. per week of the original content. In deep storage tanks, with large volumes of juice covered by a thick mass of scum, the evaporation would certainly be less, and the loss of the citric acid less; but it seems extremely unlikely that the loss would be reduced to a negligible quantity Storage of the juice for such long periods as three or four months, must result in a big loss to the planter. —*Agricultural News.*

NOTES ON POULTRY DISEASES.

Never overfeed;

Give good, plain food;

Never allow the birds to become fat; make them take plenty of scratching exercise;

Give plenty of green food;

Give as much thick separated milk as the birds will take;

Always have before them abundance of clean, cool fresh water;

Always see that they have abundance of grit and charcoal of a suitable size constantly before them;

Give them clean, well ventilated, but not draughty houses to live in;

See that the houses are rain-proof, never damp, and admit the sun's ray into all parts;

Keep the birds free from insects by occasional dipping;

Also spray the houses occasionally and so keep them free from insects;

Never waste time and money, in attempting to cure a sick bird, but kill it and burn the carcase;

Never breed except from the healthiest, strongest, and most vigorous birds;

Never under any circumstances breed from a bird that has been ill and been cured;

Hatch well and rear the chicks well, and never allow them to have any set-backs;

Exercise every care when buying fresh stock; examine it very carefully, and dip every new bird; isolate it for a week, and dip it again before putting it with your own stock. —*Rhodesia Agricultural Journal.*

OUR MILK SUPPLY.

A comparison with the results in Trinidad.

By C. B. W. ANDERSON, Asst. Analyst, Government Laboratory, British Guiana.

In the January number of the Trinidad and Tobago Agricultural Journal a paper read by Mr. Shrewsbury, Government Analyst, on the Trinidad milk supply, before the Society on the 13th January, is reproduced.

It will be interesting to make a comparison of the figures there shown and those of our own.

First we will make a comparison between the two standards in the following table:—

TABLE I.

	Fat.	Solids-not-fat.
English standard	3.0	8·5
Trinidad	3·0	8·5
British Guiana	3·25	8.5

From this it will be seen that the Trinidad and English standards of fat are similar, whereas the Colony's is slightly higher. The Colony standard was fixed by Professor Sir J. B. Harrison many years ago, as a result of hundreds of samples collected from all parts of the Colony of known genuine quality. This result is borne out by the table for 1917-1920 shown in the latter part of this article.

The following table is a comparison of the number of samples examined in each Colony during the period 1917-1919 with the extent of adulteration:—

TABLE II.

Years.	British Guiana.	Trinidad.
1917	1,612	
1918	1,675	2,427
1919	1,520	
	4,807	2,427

ADULTERATION.

Years.	Trinidad.	British Guiana.
1917	10.4	15.4
1918	10.4	15.4
1919	9.4	12.1

It is peculiar that the rate of adulteration remained the same in each Colony during 1917 and 1918.

The greater rate of adulteration in B. Guiana may be due to the following reasons:—

1. The quality of our milk is appreciably lower than that of Trinidad, which is disproved by Tables IV, V, VI, VII.

2. The lower standard of fat by law in Trinidad.

3. The percentage figures for this Colony being more reliable than that of the neighbouring Colony owing to the much larger number of samples analysed.

4. The number of samples analysed may not be an indication, as this may be due to our milk supply being in the hands of a larger number of vendors.

Even taking all these points into consideration we can safely say that the rate of adulteration is higher in British Guiana.

The half year 1920 shows an increase of the percentage of adulteration in the Colony to 17.5. Vide—Table IX.

TABLE OF THE STANDARDS OF FAT IN VARIOUS COUNTRIES.

TABLE III.

(Taken from the Trinidad Agricultural Journal.)

COUNTRIES.	STANDARDS OF FAT.
Trinidad	3.0
British Guiana	3.25
Holland	2.5
Paris	2.7
Amsterdam	3.0
Great Britain	3.0
New York	3.0
Omaha, U.S.A.	3.0
Pennsylvania	3.0
Lansing, U.S.A.	3.0
Columbus, U.S.A.	3.1
Philadelphia	3.5
Canada	3.5
Burlington	3.5
Minnesota	3.5
W.S. Treasury Dept.	3.5
Des Moins, U.S.A.	3.5

The low percentage in Holland is due to tl quality of fat in milk from a particular breed of catt

Mr. Shrewsbury shows that the mean rate of fat in Trinidad for the years 1917—1919 was 4.2, inclusive of adulterated samples, the highest case being one of 56 per cent. added water, or as low as 1.0 per cent. of fat.

The following table shows the figures for this Colony of official samples received from the Public Health Departments and Police with the exception of Berbice as worked out month by month during 1917—1920.

TABLE IV. 1917.

Months.	No. of Samples.	Average fat in Genuine and D. P.	Average fat in Genuine and Ad.
January	142	4·14	4·00
February	164	4·04	4·00
March	150	3·84	3·73
April	140	3·91	3·74
May	158	4·08	4·00
June...	148	4·05	3·90
July...	60	4·30	4·21
August	136	4·34	4·13
September	152	4·05	3·94
October	33	4·15	4·00
November	150	4·30	4·03
December	146	4·10	3·80
	1,579	4·09	3.95

TABLE V. 1918.

Months.	No. of Samples.	Average fat in Genuine and D. P.	Average fat in Genuine and Ad.
January	59	3.97	3·87
February	164	4·12	3·90
March	161	4·05	3·82
April	153	4·13	3·84
May.	123	4.09	4·03
June...	174	4·08	3·76
July...	141	4·08	3·94
August	135	4·00	3·90
September	156	4·15	4·00
October	93	4·37	4·26
November	150	4·22	4·10
December	90	4·24	4·00
	1,599	4·08	3·92

TABLE VI. 1919.

Months.	No. of Samples.	Average fat in Genuine and D. P.	Average fat in Genuine and Ad.
January	120	4·20	4·08
February	175	3·94	3·85
March	115	4·10	3·90
April	95	3·90	3·74
May	150	4·17	3·95
June...	128	4·12	4·00
July	104	4·33	4·27
August	117	4·04	4·06
September	116	4·33	4·20
October	112	4·20	4·05
November	112	4. 8	4·22
December	113	4·41	4·30
	1,457	4·17	4·02

TABLE VII. 1920.

Months.	No. of Samples.	Average fat in Genuine and D. P.	Average fat in Genuine and Ad.
January	142	4·37	4·20
February	117	4·21	4·06
March	102	4·27	4·14
April	113	4·12	4·00
May	144	4·22	4·08
June...	128	4·24	3·92
July	112	4·51	4·20
August	136	4·50	4·32
September	103	4·27	4·06
October	131	4·13	3·90
November	118	4·21	4·00
December	158	4·13	3·83
	1 524	4·27	4·00

TABLE VIII.

YEARS.	Genuine and D.P.	All Samples.	Average fat in Genuine and D,P. 1.	Average fat in Genuine & adulterated. 2.
1917 ...	1210	1579	4·09	3.95
1918 ...	1356	1599	4·08	3.92
1919 ...	1329	1457	4·17	4.02
1920 ...	1286	1524	4·27	4.00
		6159	4·15	3.99

From these tables you can form a supplementary table viz.:—

AVERAGE FAT IN GENUINE AND ADULTERATED MILKS.

Trinidad ...	4.2	(1917-1919)	
British Guiana ...	3.99	(1917-1920)	Ref. table viii.
England ...	3.7		

Table VIII shows that the average fat for all samples has increased during the last two years.

As a true indication of the approximate average fat in B. Guiana, it would be more accurate to use the figures indicated in 1 Table VIII, as this represents an average from Genuine and D.P. samples and elliminates the obviously adulterated samples. This shows that the standard in this Colony is also not too high.

If these were worked out on only genuine samples the average fat would he well over 4.2%.

TABLE IX.

RATE OF ADULTERATION MONTH BY MONTH DURING YEARS 1917—1920.

MONTHS.	1917.	1918.	1919.	1920.
January ...	18.3	6.7	8.3	18.3
February ...	17.0	15.2	8.5	14.5
March ...	10.6	12.4	14.7	12.7
April ...	17.1	13.6	12.6	23.9
May ...	13.3	11.4	16.0	16.0
June ...	14.8	29.3	10.1	22.6
July ...	11.6	17.7	4.8	26.7
August ...	15.4	11.1	10.2	9.5
September ...	13.1	16.0	8.6	15.5
October ...	21.2	10.7	17.0	22.1
November ...	16 0	12.6	8.0	25.4
December ...	23.3	16 6	18.5	26.0

This table shows that on the whole the rate of adulteration from month to month does not vary very considerably, but it is noticeable that December contains very high percentages in all the years. This is probably due to the increased demand for milk during the Christmas Season.

During these four years the following cases of high percentage of fat have occurred :—

February, 1918	... ...	11.% Fat
September „	... ...	13. „ „
January, 1920	... ...	11. „ „
July „	... ...	17. „ „
August „	... ...	19. „ „
September „	... ...	13. „ „

At least six cases of over 10% fat were also noted in addition to those shown above.

The remarkable case in August, 1920, of a sample of milk received from Cane Grove containing 19·0% fat is worthy of note and it would be interesting to know whether this amount has been exceeded anywhere in the West Indies.

The following are the worst cases of adulterated milk during the period:—

January, 1917	...58·3 per cent.	Fat abstracted	
June, 1918	...90·0 „ „	„ „	
February, 1919	...64·0 „ „	„ „	Water added 57 per cent.
June, 1919	...56·0 „ „	Fat abstracted	
August, 1919	...60·0 „ „	„ „	
August, 1920	...56·9 „ „	„ „	
November, 1920	...77·0 „ „	Water added	
December, 1920	...62·0 „ „	„ „	

These cases cited prove how callous the milk vendor is towards the health and happiness of his customers In many cases I think it is not a question of water added to milk but of milk added to water.

TABLE X.

Samples of milk during 1917-1920 of 5 per cent. and over and between 4-5 per cent. fat.

Percentages	*1917*	*1918*	*1919*	*1920*	*Total.*
4—5%	523	519	555	588	2,185
5% and over	183	190	212	196	781
					2966

Of the 6,119 samples examined no less than 2,966 were over 4%. This is equal to a percentage of 48·4 (includes adulterated samples.)

Notice must be taken of the increased rate of adulteration for 1920, the rate nearly doubling itself, yet in spite of this the average per cent. of fat in all samples has remained at 4·00% viz. VIII. It will be remembered that the price of milk was under control of the Government and therefore vendors tried to make greater profits by adulterating these milks.

During the whole of 1920 and the half year 1919 this control was in force and table XI shows the remarkable difference in the rate of adulteration before and during the control and the three months that have elapsed since milk was decontrolled.

Before Control.

1917	... ..	15·4 per cent.
1918	... ...	15·4 per cent.
1919 (Jan.-Feb.)	...	8·4 per cent.

During Control.

1919 (Mar. to Dec.)	...	12·9 per cent.
1920	... ...	19·5 per cent.
1921 (Jan. to Feb.)	...	12·8 per cent.

After Control.

1921 (Feb. to May)	...	9·7 per cent.

It is seen that during the two periods 1919, the rate of adulteration increased as in the latter period Government control was in force. 1920 shows a considerable increase in the adulteration figures and this can be accounted for as follows:—It was during 1920 that the prices of all foodstuffs reached its maximum and therefore the temptation to adulterate and make larger profits was greater, and as the price was controlled the only alternative was to sell mixed milk by the addition of water. During this year, butter was also at a prohibitive price and therefore many dairies increased their manufacture of this article with a consequent temptation to the vendor to abstract his fat and yet still sell his abstracted milk at the highest price. This must have been a profitable business.

Since the decontrol this year there has been a very considerable reduction in the rate of adulteration. Sammy* now has his own way and it is hoped that as he becomes more educated in milk practice there will be a better quality and cleaner milk on the market in future.

Mr. Reid proved in the Journal of the Board of Agriculture of British Guiana Vol. xii. No. 3 that the quality of milk is not appreciably affected by scalding; the mean of his results showing that the S.N.F. is increased by 0·36% and the fat decreased by 0·14%.

* Popular Nickname for the East Indian Labourer.

A vendor cannot plead that by scalding his milk the fat has been reduced to any extent below 3.25, for let us say his milk contains 3·5 before scalding, then after it would still contain at least 3·25% and therefore no prosecution would take place.

When a true case of genuine milk is found below the quality fixed by law it is invariably due to the following reasons :—

1. Improper feeding of the cow.
2. The diseased condition of the animal.
3. Bad milking.
4. Milk should be thoroughly mixed each time a sale is made otherwise the fat rises to the surface and the first sales will be of a relatively high fat content and the last poor.

A clear instance is given by Mr. Shrewsbury in his article proving the third reason, viz. :—

Improper Milking.

Calves were frequently permitted to suck both "before and after milking. This was a bad practice "because the fore milk was much poorer in fat than the "strippings, as shown by the figures next quoted."

Per cent. Fat.

	Cow I.	Cow II.
First Pint	0·7	1·0
Last Pint	10·8	9·0

Cow III.

Portion	1	2	3	4	5	6
Per cent. Fat	1·7	1·8	2·1	2·5	3·1	4·1

It will be interesting to quote another paragraph of Mr. Shrewsbury's article as follows :—

" It had been said that the Indians took great care " of their cows and it was no fault of theirs if the animal " gave poor milk. The speaker heartily agreed and was " anxious to add that the Indians *selected* their cows and

"that the chance of one of these animals yielding milk "with less than 3·0 per cent. of fat was very small indeed, "much less even than the chances in England which were "1 in 12,000. There had been confusion about this "figure. It simply meant that from the results of a large "number of analyses it was calculated that there was a "possibility of one cow in 12,000 giving milk containing "less than 3·0 per cent. fat. This figure had been con- "fused with the percentage of adulteration of milk in "Trinidad, which also however, indicated that the "standards were not severe."

Vendors must be careful of all these points for carelessness is just as much a crime when it affects the health of the community as deliberate adulteration.

THE PRINCIPAL VARIETIES OF SUGAR CANE UNDER CULTIVATION IN BRITISH GUIANA DURING 1919, 1920, 1921.

By the Director of Science and Agriculture and the Secretary of the British Guiana Sugar Planters Experiment Stations Committee.

The following table shows the areas occupied by the principal varieties of canes under cultivation for the crop of 1921 compared with those of 1919 and 1920.

	1917	1918	1919.	1920	1921
Bourbon and other old varieties ...	16.7	13.0	13.1	8.9	8.8
Java	0.4	0.8	0.8	1.4	1.1
Barbados	7.1	6.7	5.9	5.7	4.4
British Guiana { Plns. Diamond & Providence ...	2.7	2.6	2.6	3.2	3.3
British Guiana { Botanic Gardens	73.1	76.9	77.8	80.8	82.4
	100.0	100.0	100.0	100.0	100.0

The average yields in tons of commercial sugar per acre of the principal varieties under cultivation for the crops of 1920, as deduced from the returns supplied by the managers of the sugar plantations were as follows:—

CROPS OF 1920.

	Java.		Bourbon.		D 118.	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean of all plantations ...	1·99	849	1·75	2373	1·72	2462
Maximum reported ...	3·00	5	3·44	39	2.35	7
Minimum reported ...	1·46	290	0.97	123	0·74	13

	D 625		B 208		D 419	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean of all plantations ...	1·66	24,692	1·66	2797	1·66	685
Maximum reported ...	2·5	321	2·00	7	2·38	3
Minimum reported ...	0·873	854	1·27	12	1·14	7

	◇ 185		D 145		G Trans.	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean of all plantations ...	1.64	704	1·61	3893	1·52	253
Maximum reported ...	1·98	561	2·48	86	1·85	44
Minimum reported ...	1·31	89	0·73	37	1·20	15

	Mixed.		Ba 6032.		B.H. (10) 12	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean of all plantations ...	1·63	11,476	2.44	62	2·35	57
Maximum reported ...	2·13	358	2.79	28	2·80	49
Minimum reported ...	1·01	264	2·10	34	1·90	8

	D 216		B 6450		D 167	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean of all plantations ...	2.09	31	1.77	23	1.81	117
Maximum reported ...	3.00	5	1.99	9	2.14	39
Minimum reported ...	1.45	3	1.63	6	1.32	64

	D 109		B 376		B 147	
	Yields.	Acreage	Yields.	Acreage.	Yields.	Acreage.
Mean of all plantations ...	1 67	324	1.57	331	1.49	97
Maximum reported ...	2.07	44	1.63	4	1.90	40
Minimum reported ...	1.35	37	1.50	327	1.08	57

The following tables indicate similar figures as the preceding but they are compiled from the returns supplied by the larger plantations only.

	Java		Bourbon		D 118	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean, larger plantations only	1.99	849	1.91	1230	1.81	2149
Maximum reported ...	2.00	5	3.44	39	2.35	7
Minimum reported ...	1.46	290	1.28	327	1.12	4

	D 625		B 208		D 419	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean, larger plantations only	1.82	17,568	1.66	2797	1.66	685
Maximum reported ...	2.53	321	2.00	7	2.38	3
Minimum reported ...	1.20	705	1.27	12	1.14	7

	◇ 185		D 145		G. Trans.	
	Yields.	Acreage.	Yields.	Acreage.	Yields.	Acreage.
Mean, larger plantations only	1.64	704	1,80	3730	1.55	246
Maximum reported ...	1.98	561	2.48	86	1,85	44
Minimum reported ...	1.31	89	1 14	14	1.20	15

The result of large scale field-trials with other varieties on the sugar plantations are shown in the following table :—

Variety.	Acreage.	Yield.
Diamond 35	13	2·84
P.L. 374	19	2·77
P.L. 264	20	2·45
Diamond 581	7	2.45
B. 3,412	31	2·36
P.L. 254	20	2·31
R.P. 8	420	2·30
D. 433	7	2.30
R.P. 73	56	2.29
Diamond 37	48	2.15
D. 246	1	2.14
R.P. 21	95	2·07
B. 3,922	9	1·99

SOME LOCAL PRACTICES PREVALENT IN SOUTH INDIA IN THE CONTROL OF INSECT PESTS.

The following extract from the above paper by the Assistant Entomologist of Madras which was read at the Nagpur Session of the Indian Science Congress, 1920, and which appeared in the Agricultural Journal of India, Vol. XVI., Part. I. we reproduce here as being of considerable interest to local agriculturalists and also possessing some hints of value.—EDITOR.

With regard to the various local beliefs entertained by villagers as to the causes that bring about insect outbreaks, we can find, unfortunately, very little of scientific tinge in them. The chief of these are God's curse, the alleged bad position of the planets for the season and the prediction of a local oracle or astrologer, the displeasure of a particular village deity who was not properly propitiated, a neighbour's black art or evil eyes, the approach of a polluted man or woman, a bad wind, floods, sudden and unexpected changes in the weather, and a number of other causes real and supernatural. It need hardly be stated that, with the exception of some of these which are quite evident, few of the above would generally appeal to scientific men and could therefore be brought within the realm of practical politics. However, one or two interesting points with regard to some of the prevailing local beliefs on the origin of crop pests may be mentioned here. The appearance or disappearance of insect pests is very often associated in different parts of South India with the appearance and the direction of the winds; this is especially the case in the delta tracts of Godaveri and Kistna; the *payirgali* and the *thoorpugali* have their own significance and are regarded as very important by the agriculturists. A good deal of stress is also laid on the time of sowing particular crops to avoid pests, and I have heard from

experienced and educated ryots that in some cases early sown fields, and in others late sown ones, suffer from pests. Such beliefs are entertained in many places and are probably the conclusions of years of experience, and as such we are not yet in a position to belittle them though convincing scientific explanations for such phenomena have not yet been found out to confirm such views.

Now, coming to the control measures adopted, we might consider these under the following convenient heads :—

Religious or faith cures.

In most villages many of the farmers, believing as they do in supernatural causes of insect outbreaks, naturally do nothing; they think that the curse of God should run its natural course. At the same time there are others who resort to faith cures such as charms, *mantras*, magic, and so on, in the belief that the curse may be avoided or cleared. Most of these methods consist in getting the professional local soothsayer or magician to perform some ceremonies to drive the pest and save the crop. While once in the South Arcot District in connection with the study of the leaf miner (*Surul*) pest of groundnuts, I came across a professional pest driver who reluctantly wrote me out a Sanskrit couplet, which he told me in confidence was very effective in checking pests. The verse is to the effect that all sorts of pests can be driven by means of a talisman prepared and fixed by an individual born of a particular *gotra* or sect among *dwijas* or the twice-born. The procedure consisted in this man preparing three small slips containing the verse written down and having these buried at the three corners of an infested plot on a Sunday morning. It is believed that the pest clears out through the fourth corner of the plot. I have given this one instance just to give an idea of some of these ludicrous methods in vogue. I am told that in parts of Cochin and Travancore, when paddy fields are infested with pests like the rice-bug, etc. Christian ryots often resort to the method of sprinkling on the infested fields sanctified water obtained from Catholic priests. To ward

off the effects of the evil eye which is said to produce injury or disease to crops and in which many literate people have faith, there are curious devices employed in different places. Very often a field with a promising crop, if it happens to be situated by the side of a thoroughfare, is often protected from the evil eye by the prominent exhibition of some curious object in the middle of that plot, such as a skull, a dead crow, a stuffed figure of an unnatural man or woman, a painted pot on a pole, etc.

In gardens where betel vines and grapes are grown, visitors are not usually allowed admission, and in the former case never with one's shoes on. While inside a betel vine garden once in the Tanjore District, where I was reluctantly allowed admission by the owner, I just overheard a conversation to the effect that no higher caste man should be allowed into a betel vine garden, because the garden will suffer from the evil eye. Some of the local methods reported to be resorted to in villages in some parts of the North Arcot District against caterpillar pest on paddy were the sacrifice of a goat to the village deity and making cooly girls perform a ceremonial dance near the infested field. The various harvest festivals called *pongals*, *pujas*, etc., performed as thanksgiving for a good crop, and prayers for a future good crop, are also said to have some significance in keeping off insect pests.

In spite of the funny and curious nature of many of these methods, many cultivators still have faith in these cures and cling to those practices. One reason for this, so far as I have been able to make out, is this : In some cases of pest outbreak, such as swarming caterpillar, the time of the sudden disappearance of these creatures into the soil or otherwise due to their peculiar habits synchronizes with the apparent inactivity period soon after some faith cure is adopted.

We will now come to consider other local methods which appear to be of a practical nature. Though many of these are carried out in most cases without the know-

ledge on the part of the ryots as to their bearing on insects or on their habits, some of these practices have been found to produce the desired results.

CULTURAL METHODS.

Weeding. Very few farmers will admit that they carry out this process of weeding to check insects; but in effect this method goes a good way in checking insect pests. I know that in parts of South Kanara, in the villages along the Ghâts, where the rice-bug is a bad pest, the cultivators believe that periodical burning of the jungle grass around their paddy fields reduces the pest considerably, and there is a good deal of scientific truth underlying the same.

Flooding. In parts of the Godaveri Delta, flooding of paddy fields is adopted to check swarming caterpillar (*Spodoptera*) attack. In some villages of the Coimbatore District, the same method is resorted to in betel vine nurseries where the young *Sesbania* (*agathi*) plants are attacked by the caterpillar *Prodenia*. In both these cases, the result is effective and brings up the caterpillars which become a prey to insectivorous birds of sorts.

Draining of water. This is believed to check rice Hispa in some villages of South Kanara. I have also read of this practice in parts of Bengal for the same pest. I am not quite sure as to whether this practice does not prevail in some places in the treatment of the rice-case worm (*Nymphulla*) also.

Selection. In the well-known tabacco areas in the Godaveri *lankas*, before the seedlings are transplanted into the fields from the nurseries, there is a system of weeding out sickly seedlings and those that show a sort of swelling at the stem which is caused by the stem-borer of tobacco (*Phthorimœa heliopa*); many of the tobacco growers are familiar with the pest and this sort of selection is found to do immense good. But what unfortunately lessens the good effect of this intelligent measure is the rather imperfect way in which the discarded seedlings are disposed of; they are not destroyed but left on the field bunts, thus

helping many of the borers in these stems to live on and infect healthy fields.

Growing of mixed crops. Just as weeding, this is also a very well-known and common practice in many dry land tracts, and, as in the case of weeding, it is doubtful whether the cultivator ever thinks of insect pests in this connection. However it be, there is no doubt that this mixed cultivation of different crops certainly contributes its own share in reducing insect pests.

Seasonal ploughing. Though this is not done regularly with special reference to the control of insect pests, in most cases there is no doubt that this method has its own insecticidal value—especialy when it is done after an attack of hairy caterpillars, grasshoppers, cockchafers or cutworms. In South Kanara when small plots of paddy are badly infested with Hispa in the third crop plots, the farmers plough up the fields and sow pulses.

III.—Mechanical methods.

In different parts of the country when farmers find that their infested fields are still bad in spite of all faith cures and agricultural methods, they resort to the trial of various Mechanical and other methods of a practical nature. Among these are :—

Netting, bagging, etc. For pests like locusts, rice-bug, swarming caterpillar, etc., it is a well-known practice in parts of Malabar and Travancore to destroy these by collecting them in bags, nets, winnows, etc. Though worked on the same principle, the contrivances are of various kinds. In some places paddy winnows are used, in others a sort of bamboo winnow with a long handle is used. I have also seen caterpillars being swept by brooms into baskets and ordinary bamboo umbrellas used as bags to collect very young green caterpillars (Plate V, fig. 3). In one place in the Coimbatore District, where paddy seedlings were badly infested with surface grasshoppers of sorts, I found that the farmers used to drive the hoppers to one corner of the plot and beat them to death by means ot palmyra leaves, their long stalks being used as handle. Cotton clothes used as upper clothes or headgear by the

ryots are also improvised many a time to serve as sweeping bags and worked by two or more men,

Smoking and burning. In parts along the Malabar Coast, a system of creating smoke to drive away the rice-bug is found. The same method is adopted in other places to drive away blister beetles which damage cereals in flower.

The nests of troublesome wasps and bees are also often scorched by a burning torch, generally at night.

Other mechanical methods. To check the rice-case worm in paddy fields, it is a custom, chiefly in parts of North Malabar to drag a thorny tree branch across the infested field, which makes the small cases of the worms drop down into the water. This is also said to be practiced in the North Arcot District for leaf caterpillars like *Melanitis*, etc.

The covering with muslin or paper bags of ripening fruits of good varieties of pomegranates, mangoes etc., is a practice in many gardens all over the country and this certainly have some deterrent effect upon fruit-borers like borer caterpillars and fruit flies.

The use of ant pans in houses to keep away ants from sugar-jars, meat-safes, dairy products, etc., is quite an old custom, as may be seen from the crude granite ant pans used by silk farmers in Mysore, to protect their *mejas* containing silkworm trays.

The hooked wire is commonly used in parts of Tinnevelly to extract the rhinoceros beetle from coconut shoots.

A very interesting and intelligent method of catching winged termites is in vogue in parts of the Coimbatore District. It is, of course, done not with the idea of destroying the pest, but with the purpose of collecting them in numbers for edible purposes. It is probably not very widely known that some of the low caste cultivators regard the winged termite as a delicacy ; during certain seasons these are sold in bazaars of different towns. I have also heard that among some castes this substance forms one of the important articles of dowry for a bride! Though resorted to for edible purposes, it must be admitted that this method checks the multiplication of this undesirable insect to some extent. The procedure is as follows :—

Just before the usual season when these *winged* termites emerge, and which the professional catcher knows, a shallow pit is made close to a termite mound and this is filled with water ; this pond is enclosed on three sides by a sort of fencing, the side adjacent to the mound being kept open. A small lamp is lighted and placed at the edge of the pond. After all this paraphernalia is arranged, the catcher sprinkles some water over the termite mound and in a few minutes swarms of winged termites emerge. These naturally hover about the light and drop into the artificial pond, when they are collected by the operator.

In the Ghât regions along the Western Ghâts, and in the Nilgiris and Mysore, it is a pretty common sight to see the bulls of hill carts having suspended from their neck a big brush-like tuft of wool generally black in colour. I have tried to get the meaning of this extra ornament from cart-drivers, but have been told that they are charms to protect the bulls from diseases. Whatever it is, I find from what I have observed that this tuft of wool keeps away to a considerable extent the biting flies that worry cattle in these hill tracts. Any one travelling in these tracts will notice the havoc done by these flies to cattle, and I am led to think that this tuft of wool is an effective preventive against fly pests.

IV.—Medicinal methods.

materials. In the Adoni Taluk, the smoke is produced by burning hides and hoofs of cattle to drive away blister beetles attacking dry crops; in the Dharmapuri Taluk of the Salem District, on the other hand, there is the curious system of burning pig's fat to fumigate a field infected with rice Hispa. There is no doubt that some temporary relief is got by creating smoke, but this latter system of using pig's fat does not show any appreciable effect on the rice Hispa. Speaking of the method of smoking, many of us are, I believe, aware of the burning of frankincense and resinous gums in houses to keep away mosquitoes; but I don't know whether burning and creating smoke with the dung of elephants and horses for mosquitoes is so very widely prevalent, I have seen this in parts of Malabar, Anantapur and Cochin.

Banding with art of posts and trees against termites and the use of kerosine against ant nests in buildings, are methods too well known to demand any special remark. Climbers, when they go up trees like mango infested with the troublesome red ant (*Ocophylla*), often carry with them pouches containing ashes which they splash against trains of ants on the tree branches.

I have seen in some parts along the West Coast that fermenting starchy liquids are exposed in coconut gardens and this is found to attract chafer beetles of all sorts,

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In the Ghât regions along the Western Ghâts, and in the Nilgiris and Mysore, it is a pretty common sight to see the bulls of hill carts having suspended from their neck a big brush-like tuft of wool generally black in colour. I have tried to get the meaning of this extra ornament from cart-drivers, but have been told that they are charms to protect the bulls from diseases. Whatever it is, I find from what I have observed that this tuft of wool keeps away to a considerable extent the biting flies that worry cattle in these hill tracts. Any one travelling in these tracts will notice the havoc done by these flies to cattle, and I am led to think that this tuft of wool is an effective preventive against fly pests.

IV.—Medicinal methods.

We might now examine some of these methods which more or less correspond to what entomologists call insecticidal methods.

The commonest practice in vegetable gardens against insect pests of all kinds, no matter what their habits are, is the use of ashes. It will be found used for brinjal fruit and stem borer, *lablab* aphis, cucumber fruit fly, brinjal *epilachna* and many a common vegetable pest.

Once in a village in the Salem District, I saw ordinary white-washing lime being splashed on *lablab* vines against plant-lice.

An improvement in the meehanical method of smoking is found in the following two cases where some extra effect is attempted to be produced by smoking special

materials. In the Adoni Taluk, the smoke is produced by burning hides and hoofs of cattle to drive away blister beetles attacking dry crops; in the Dharmapuri Taluk of the Salem District, on the other hand, there is the curious system of burning pig's fat to fumigate a field infected with rice Hispa. There is no doubt that some temporary relief is got by creating smoke, but this latter system of using pig's fat does not show any appreciable effect on the rice Hispa. Speaking of the method of smoking, many of us are, I believe, aware of the burning of frankincense and resinous gums in houses to keep away mosquitoes; but I don't know whether burning and creating smoke with the dung of elephants and horses for mosquitoes is so very widely prevalent, I have seen this in parts of Malabar, Anantapur and Cochin.

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I have seen in some parts along the West Coast that fermenting starchy liquids are exposed in coconut gardens and this is found to attract chafer beetles of all sorts, including the coconut rhinocerous beetle.

It is reported that the use of the powdered cake of the fruit of the Maravitti tree (*Hydnocarpus wrightiana*) checks this coconut beetle and is said to be used in parts of Travancore.

Apart from the manurial value of several oil-cakes applied by farmers to growing crops, such as *nim* (*Melia*) castor, groundnut, some of these possess some insecticidal value of their own, though how far the farmer realizes it is a doubtful point.

In many interior villages different kinds of vegetable drugs are being used in various ways in the belief that

they check pests; though many of these are of doubtful value, there are some which show promise of efficacy and which are therefore worth trial at the hands of scientific men.

In different parts of the country stored products, especially grains, are preserved in bins together with the leaves of *nim* (*Melia*) or *nochi* (*Vitex nojinda*) plants; the latter I have seen in parts of South Arcot and Tanjore and the former is, I hear, used to preserve horse-grams, etc., in parts of the Kurnool District. For my own part I doubt whether these have any insecticidal value in keeping away store pests. In some villages along the Mysore uplands, such as Kollegal, grains like *ragi* (*Eleusine coracana*) are stored in underground pits and these keep quite free from pests.

I have recently come to know of a very interesting method of preserving stored products in parts of Mysore, which is by keeping a small quantity of pure mercury in the same bin, and it is said to be very effective.

Speaking of the preservation of stored grains, etc., in general, the method in which store-sheds or granaries are built in different places appears to be more or less satisfactory. The bigger granaries are often built with stone pavement, higher up the ground level, and in most cases are as insect and damp-proof as possible. I have seen this to be the case in many villages in the Circar. In the South Arcot and the adjacent districts cheap insect-proof seed bins are found to be used. These are made of earth or bamboo matting, and when properly covered and plastered with cowdung, as is usually the case, the seeds or grains remain quite healthy and more or less free from vermin.

V. Other methods.

A very curious method of driving insect pests has come to my knowledge very recently. It seems that the following method is adopted in the Adoni Taluk of Bellary District to drive blister beetles. One live beetle is caught and smeared with or dipped in a mixture made up of asafœtida, cow-dung, lemon-juice, etc., and is then let lose among the companions, and it is believed that all the

beetles are driven away from the field where this dipped beetle is liberated ! This method more or less approaches the modern method of spreading infection with fungi, bacteria, etc., to drive insects.

The use of natural enemies against insect pests is, of course, still in its infancy even in many advanced countries; however, see such an idea in the practice of letting loose ducks into fields infested with swarming caterpillars or grasshoppers—a practice that is noted in parts of the Chingleput District ; the results appear very encouraging.

The above are some of the various indigenous practices I have been able to note, and it is quite possible that many others exist which have escaped my notice. Therefore I must admit that this paper does not exhaust all the local practices found in different parts of the country.

BOTANICAL, PLANT DISEASES AND PEST NOTES.

SOME OBSERVATIONS ON A LOCAL SPECIES OF MOSQUITO.

Extract from the Official "Gazette" of 26th March, 1921.

Sir,

I have the honour to submit herewith the report on my investigations concerning the present mosquito plague in New Amsterdam; the work was performed at the suggestion of the Honourable the Colonial Secretary.

2. A plague of mosquitoes lasting several weeks and gradually diminishing is no new phenomenon in New Amsterdam and the County of Berbice generally; a number of writers during past years have recorded the abundancy and virulency of the mosquitoes in Berbice at

certain seasons. Several popular theories exist as to the origin of these pests; one widely accepted theory is that these insects originate in the large areas of swamp lands that exist on the Corentyne Coast and are blown down wind to New Amsterdam.

3. Investigations during this visit disclosed the fact that the present mosquito plague is directly due to the activities of one particular species of mosquito.

I collected specimens and made observations at a number of points both within New Amsterdam and along the swamp land fringing the river bank. In every instance the one species predominated. I refer to the well known *Aedes taeniorhynchus*, Wied. I state "well known" as the insect has, among other localities, been recorded in New York, Louisiana, Texas, Mexico, British Honduras, Guatemala, Nicaragua, Costa Rica, Panama, Trinidad, Brazil and Suriname.

Its breeding habits and the behaviour of the adult insect are also known. The following extracts from Howard, Dyar and Knab's well known monograph on the mosquitoes of North and Central America and the West Indies, Vol. IV, Part 2, concerning this mosquito will prove of interest.

P. 670. "The larvae live in brackish or fresh water "pools near the sea. . . . . The eggs are laid in the mud "and hatch when the pools are filled, a set of larvae "appearing on each such occasion."

P. 671. "Dr. Dyar found the larvae upon the salt "marshes of Southern California, where a brood appeared "in the highest pools at each monthly high tide."

P. 671. "In Mexico and Central America Mr. Knab "frequently found the larvae in large numbers in pools of "rain water, but only within the tide water region."

P. 671. "As to the bite, that is much like that of "*sollicitans* and, like that species, *taeniorhynchus* takes "no long thought in reaching a proper spot, any exposed "place will answer and it has the same ankle-seeking "propensity that its allies have."

P. 671. "In the warmer parts of Continental "America *Aedes taeniorhynchus* is the common coast

"species and sometimes appears in enormous numbers "when conditions favour the production of a brood. It "has the same tendency to migrate as *A. sollicitans* has "and has been taken far inland. Swarms of this mos- "quito have been reported at sea, in the Gulf of Mexico, "many miles from land."

With regard to this latter point several people have informed me that they have been attacked by swarms of mosquitoes whilst on board ship lying out at sea some distance from the coast of Suriname. Probably this same species is implicated.

Local observations on the habits of this mosquito are to be found in the British Guiana Medical Journal for 1913, where the Rev. James Aiken in an article on British Guiana Mosquitoes makes the following observations.

P. 37. "The rains of May, 1912, were succeeded by "another exceptionally dry season, which broke in Berbice "on 1st December and on 12th December. I noted *Aedes* "*taeniorhynchus* in numbers which increased greatly dur- "ing the remaining days of December and early part of "January, 1913."

In the same Journal for 1908 in another paper, this observer states :—

P. 20. "*Aedes taeniorhynchus* is a blundering "creature in comparison with any of those mentioned. "During the day she does not fly high and even in shade "beneath a house will bite only on the hands as they hang "by the side and on the face only if one is stooping so "that it comes within three feet of the ground. She is "slow witted and when settled waits calmly while the "hand is lifted and the point of the finger pressed gently "but firmly on her back. At night she comes in swarm, "at times into dwellings and swells the crowd of *fatigans* "*cubensis*, and other Culices, Stegomia and Anopheles "which combine after dark to break the peace of the "lieges in the colony."

My experience with this mosquito both on this occasion and for a number of years previously has been similar to the above. It is a clumsy, greedy, fearless

insect imbued with a very earnest desire to feed either at night or in the hottest midday sun. It has a distinct preference for those exposed parts of the anatomy from the waist downward.

Last week, in the New Amsterdam Botanical Gardens, one almost waded through clouds of this insect only a few of which rose higher than the waist. With a view to discovering the breeding places of these swarms I made a close survey of the swamp lands by the banks of the Berbice River in the vicinity of New Amsterdam. Fully 80 per cent. of the crab holes, more noticeably those on the drier parts of these swamps, contained numbers of the larvae of this pest. No pupae were taken and none of the larvae were more than three-quarters grown.

I also found a few young larvae in brackish pools apparently formed by the recent rains but now rapidly drying up.

Many adult mosquitoes of this species were observed to issue from the crab holes when opened up. The fact that this insect breeds in crab holes has already been recorded from Brazil.

I may mention that the clouds of mosquitoes which occur at eventide on the Sea Wall, Georgetown, at certain seasons are of this same species.

4. I am of the opinion that the sudden swarms of the *Aedes taeniorhynchus* which appear in Berbice are due to the fact that the eggs are deposited in the mud in the littoral swamps and—are capable of there lying dormant till a supply of water comes to hand which may be brought about by an abnormally high rainfall.

During a long period of dry weather the eggs would accumulate in immense numbers, which, given a sudden adequate supply of water, would simultaneously hatch and produce a great swarm of adult mosquitoes.

The adult mosquito "carries on" during dry seasons in crab holes or other convenient deposits of water.

The breeding place *par excellence* of this mosquito is the vast swamps to be found along the coastal regions in Berbice and in *close proximity* to New Amsterdam; it is from these areas that the swarms issue forth and descend upon the inhabited places of the County.

I have the hononr to be,

Sir,

Your obedient Servant,

G. E. BODKIN,
Government Economic Biologist.

The Director,
Science and Agriculture.

Coushi Ants.

SOME NOTES ABOUT THEIR HABITS AND SATISFACTORY ELIMINATION.

Leaf cutting or Parasol Ants (known locally as Cooshie ants) are easily the most dangerous enemies to vegetation in these parts of Tropical America in which they occur. Their peculiar habits of cutting off fair-sized pieces of leaves of various trees which they carry back to their nests held upright in their jaws is well known to everyone who has lived in this part of the world. They march along regular tracks, one after the other, and their columns which are often of great length consist of two streams going in opposite directions to each other, the one composed of the ants laden with their booty returning to the nest and the other of ants which have deposited their pieces of leaves in the nest and are coming back for more. They have been observed to go as far as half-a-mile from their nest to attack certain trees although other trees on which they are known to prey are to be found within a

much shorter distance. Not only leaves but also pieces of flowers, fruits and seeds are taken back to their nests.

These nests, which are usually situated in a spot in the forest clear of large trees, are often of huge size measuring up to 30 feet across and even more, while underground tunnels run from them in different directions for long distances. There are always a number of openings leading into the nest.

For a long time naturalists were puzzled as to what use was made of the pieces of leaves after they were taken into the nest. By some, the ants, were believed to use them directly as food; others imagined that they used them for roofing the underground parts of the nest. In his excellent book "The Naturalist in Nicaragua" Thomas Belt, who was a mining engineer by profession, made the suggestion, which has since been verified, that the leaf-eating ants use these pieces to form beds on which they grow a certain species of mushroom which serves as food for themselves and their young.

Inside the nests these pieces of leaves are cut up very finely and kneaded with their feet and jaws forming a yellowish-brown spongy substance, in which no particles of the original leaves can be distinguished, on which the fungus is grown. This particular fungus is carefully looked after and cultivated and all other kinds of fungi, which we might call 'weeds' are prevented from growing. So carefully and intelligently is this carried out that the ants have been able to produce a new growth in the fungus, as different as many of our cultivated fruits and vegetables are from their original wild forms. In many cases if has been proved that if the ants are deprived of this special food they die of hunger.

It has been discovered that each of the female ants—large dark-brown, fat bodied creatures measuring nearly $\frac{3}{4}$ inch in length, with two pairs of large brown wings, which may be seen issuing from the nest at certain times of the year—carries in a cavity at the back of her mouth a pellet consisting of filaments of this fungus, with which she is able to establish a fresh fungus garden when she starts making a new nest.

PLANTS ATTACKED.

The Cooshie Ant shows a decided preference for certain kinds of cultivated plants such as roses, oranges, coffee, mango, avocado pear, etc. As a rule introduced plants suffer much more than the plants indigenous to the regions where the ants are found. Many of the latter have special adaptions or contrivances for keeping away leaf-cutting ants, amongst which are the provision of special dwelling-places in their stems, leaves or thorns, and also food for certain other ants of a warlike disposition which, while they cause no injury to the plant which harbours them, at the same time protect its leaves from the attacks of the Cooshie ants. Some six or seven different species of this ant are known to occur in British Guiana. The large brown species found along the Coastlands is the commonest and most destructive. Smaller species occur in the soils of the North West District and the far interior.

METHODS OF DESTRUCTION.

Since Mr. Belt's classic experiments in 1874 on the extermination of these ants which consisted in the use either of carbolic acid and water, mercuric chloride, tar, or in some cases the interment of a dead animal in the centre of the nest, innumerable experiments with a great variety of substances have been tried. Methods of elimination by mechanical means have also been tested. Belt summed up his experiments pretty accurately by remarking that if the ants were sufficiently worried they evacuated their quarters only to migrate elsewhere. None of his attempts, therefore, were entirely successful. Methods of pumping various noxious gasses down into the nest have been devised but none have ever proved anything like final in their effect.

Pumping sulphur dioxide gas into the nest I experimented with myself some 7-8 years ago but got no positive results ; I have heard that this same method was attempted on a large scale at His Majesty's Penal Settlement fully twenty years ago but proved useless.

Coushi ants and their nests can be destroyed with

certainty either by means of 'puddling' (which is a mechanical method of destruction) or by the use of carbon bisulphide.

Puddling can only be indulged in on soils of a heavy nature; it is no good on a sandy soil. Carbon bisulphide can be used on any soil.

The method of puddling is too well known to need description here. The use of carbon bisulphide is not so well known and may be described as follows:—Having satisfactorily located the nest all exist holes are carefully and thoroughly closed up with well ramed earth. Towards the centre of the nest and, according to its size, two or more of the larger exit holes are left open. Down each of these holes are poured about a couple of fluid ounces of carbon bisulphide. The holes are then closed up for several minutes. A torch is meanwhile constructed consisting of dry 'bush' tied to a long stick. The bush is then set fire to, the holes uncovered and the torch applied. The necessity of having a long stick will then become apparent for, as soon as the flames approach the hole a violent underground explosion takes place which is repeated at varying intervals as the flame of the first explosion penetrates the distant underground galleries of the ants. All the holes left exposed are thus 'touched off'.

The theory of the procedure is that carbon bisulphide which is a very highly inflammable, volatile liquid with a pungent smell on being poured into the hole quickly volatilizes and mixes with the air, this mixture very rapidly penetrates into the remotest parts of the nest and, as soon as the flame is applied, explodes with violence.

Properly handled—and such is not difficult—this method of destroying coushi ants is perfectly successful and the largest nest can be eliminated with certainty, ease and simplicity. No expensive machinery is necessary and any individual possessed of ordinary intelligence can satisfactorily perform the operation with but little or no practice.

G. E. BODKIN,
Government Economic Biologist.

Bamboos.

Most of the bamboos of America belong to genera peculiar to the New World, *Guadua* taking the place of *Bambusa*. *Chusquea* that of *Schizostachyum*, etc , only *Arundinaria* and *Nastus*, perhaps, being indigenous to both hemispheres, although some Asiatic species have become naturalized in the West Indies. The reed-bamboos (*Arundinaria macrosperma* and *A. tecta*) which are of no great height, from the low-lying extra-tropical 'cane-breaks' which characterize the most northern extension of the group on the Continent, the first-named occurring in Florida and on the shores of the Mississippi and in Arkansas, whilst the second is found in Kentucky and near Philadelphia. Forty years ago a considerable quantity of paper-pulp was annually made from *A. macrosperma* in North and South Carolina, and the lowlands of the Mississippi. The cane was cut into pieces, tightly packed in cast-iron cylinders, 22 feet long and 1 foot in diameter, known as 'guns,' fitted with very strong steam-domes. After fifteen minutes treatment with steam at 180lbs. pressure, the cane was shot out of the gun against an iron sheet by the sudden opening of one end of the cylinder, and thoroughly disintegrated by the expansion of the compressed absorbed steam. The utilization of this species by modern methods is now under consideration in Louisiana.

Most of the taller species of the small related genus, *Arthrostylidium* occur at high altitudes. The slender *Arthrostylidium racemiflorum*, for instance, grows at 6,500 to 7,500 feet in Mexico, and the taller and stouter *A. Schomburgkii*, the long, basal joints of which—the longest of known bamboos—are used for the native blow-tube or 'sarbican' occurs at 6,000 feet in Guiana, and in the mountains near the sources of the Orinoco and Rio Negro. *Chusquea aristata* occurs in the same region, in dense thickets, at 13,000 to 15,000 feet. *Guaduaangustifolia*, which grows to 30 or 36 feet in height, and to 6 inches in diameter, is described by Humboldt as 'forming forests several leagues in extent, in hot valleys and at

moderate elevations' (about 2,400 feet) in Ecuador and Colombia, but the species of this genus probably more often occur in comparatively small thickets.

A considerable portion of the area occupied by gregarious bamboos in Trinidad is made up of introduced Asiatic species, especially *Bambusa latifolia,* though the nearly allied Venezuelan species, *Guadua latifolia,* also occurs; and, at high altitudes the large *Arthrostylidium excelsum,* and *A. pubescens* are found. Paper has for some years been made in Trinidad more or less completely from bamboo pulp, and Messrs. Nelson, of Edinburgh, have a concession for cutting bamboo in the Government forests, and have planted 1,000 acres near St Joseph, 7 miles from Port-of-Spain.

Though bamboos occur generally throughout Jamaica, they do not occupy extensive continuous areas; and although under present conditions they might be remuneratively cultivated, a London newspaper, which some years ago took for a time a considerable quantity for paper making, abandoned the enterprise because the supply was inadequate. So, too, in British Guiana, though several useful species occur sporadically, and there would be little difficulty in cultivating them, they do not appear at present to occupy any large continuous areas.—*Bulletin of the Imperial Institute, 1920.*

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the first six months of 1921. The corresponding figures for the two previous and the average for the four years previous to that are added for convenience of comparison.

Product.	*Average 1915-18.*	*1919.*	*1920.*	*1921.*
Sugar, tons ...	41,873	37,167	36,329	34,251
Rum, gallons	1,948,345	3,036,093	1,011,761	1,582,575
Molasses, gallons	2,167	171,247	None	None
Cattle-food, (Molascuit) tons	912	818	552	1,055
Cacao, cwts. ...	91	None	8	None
Citrate of Lime, cwts.	116	83	229	34
Lime Juice, gals.	3,078	7,551	—	441
Essential Oil of Limes, gals.	117	136	—	108
Coconuts, thousands	926	2,328	2,218	1,456
Copra, cwts. ...	988	864	296	599
Coffee, cwts. ...	1,579	7,128	2,989	390
Kola-nuts, cwts. ...	2	None	10	None
Rice, tons ...	7,622	1,288	8,036	4
Ricemeal, tons ...	86	None	None	None
Cattle, head ...	352	1	—	None
Hides, No. ...	1,471	3,769	3,405	1,832
Pigs, No. ...	402	None	None	None
Sheep, head ...	11	None	136	None
Balata, cwts. ...	4,628	2,262	2,167	3,469
Charcoal, bags ...	24,205	22,764	24,785	23,268
Firewood, Wallaba, etc., tons ...	4,833	4,339	2,708	3,491
Gums, lbs. ...	248	315	3,361	7,913
Lumber, cub. ft. ...	88,374	84,311	130,330	49,315
Railway sleepers, No.	3,698	1,508	4,707	3,114
Rubber, cwts. ...	34	51	118	6
Shingles, thousands	1,170	1,336	883	1,012
Timber, cub. ft. ...	38,913	38,825	29,587	83,097
Coconut Oil, gals....	13,532	4,451	24,971	7,705

ERRATUM.

Vol. XIV. No. 2. April, 1921. Page 141.

"Exports of Agricultural and Forest Products"—Sugar export for first quarter, 1921, should read 15,864 tons.

ATTENDANCES AT THE DISTRICT GARDENS

Year.	Bourda.	Belfield, E. Coast.	Stanley, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,200
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,886
1918 ...	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919 ...	4,769	2,425	1,582	2,798	1,851	2,480	1,556	17,461
1920 ...	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921 ...								
st Quarter	1,761	639	502	307	673	829	490	5,201
nd Quarter	1,790	554	410	1,408	549	812	430	5,953

Meteorological Data—April to June, 1921.

Months	Rain-fall.	NUMBER OF DAYS OF RAIN						Evaporation.	Air Temperature and Humidity.			
									Air Temp.			Humidity.
Botanic Gardens.	Total Inches.	Under ·10 Inches	·10 to ·50 Inches	·50 to 1.00 Inches.	1.00 to 2.00 Inches	Above 2.00 Inches	Total days	Inches	Maximum	Minimum	Mean	Mean
April ...	8.56	8	8	4	...	1	21	4.65	84.7	76.0	80.3	79.1
May ...	1.20	5	3	...	...	...	8	6.60	85.0	78.4	81.7	72.1
June ...	21.15	4	14	5	3	3	29	2.90	84.6	74.6	79.6	82.9
Totals & Means.	30.91	17	25	9	3	4	58	14.15	84.7	76.3	80.5	78.0
Onderneeming.												
April ...	8.56	5	6	3	3	...	17	...	87.4	72.6	80.0	...
May ...	2.09	3	7	...	...	...	10	...	88.1	72.7	80.3	...
June ...	11.52	2	14	5	3	...	24	...	88.1	72.7	80.4	...
Totals & Means.	22.17	10	27	8	6	...	51	...	87.8	72.3	80 2	...
Berbice Gardens.												
April ...	11.35	1	7	5	1	2	16	...	83.4	74.8	79.1	75.7
May ...	2.52	...	2	1	1	...	04	...	82.7	75.0	78.8	88.2
June ...	15.37	3	18	5	4	...	30	...	81.9	75.2	78.5	73.3
Totals & Means.	29.24	4	27	11	6	2	50	...	82.6	75.0	78.8	79.1
Morawhanna												
April ...	16.13	2	10	1	2	3	18	...	...	...	...	...
May ...	8.75	3	11	2	1	...	17	...	...	...	...	...
June ...	22.74	4	10		5	2	30	...	...	...	...	...
Totals ...	47.62	9	31	12	8	5	65	...	...	...	...	...

CHEMICAL ANALYSIS OF SOILS: ITS VALUE AND LIMITATIONS.

By Jas. Crabtree, M.Sc., F.I.C.

During the past decade an appreciable alteration has been manifested in the attitude of the practical man towards the scientist in nearly every industry, a change impelled chiefly by the increasing intricacies of most industrial processes, occasioned by their developments, and one which is likely to progress with further advances. Formerly misunderstood, and regarded as an abstruse dreamer, the scientist is coming to be regarded in his true light; "science" means "knowledge" and the scientist is a knowledge specialist, an individual whose function is the acquisition of information of the fundamental laws of nature which are the basis of every change or process, and the application of such information to the improvement of such processes and changes as are necessary to the most economical production of those materials on which man is dependent for his welfare and comfort.

In the swing of the pendulum away from distrust of the scientist there is a tendency, perhaps unavoidable, of going too far in the other direction, and expecting too much from this worker. Too often is he regarded in the light of a kind of wizard possessed of mystic powers and store of knowledge, an impression which it is to be feared, is in some cases not violently discouraged by the individual himself. He is, however, but human, and probably encounters more insoluble problems than most of his brothers in other walks of life; a closer comprehension by the latter of the limitations of the knowledge at his disposal, and the difficulties which beset his way, cannot but lead to a greater appreciation of the results he obtains.

In indeavouring to arrive at some conception of the value and possibilities of the work of the scientist, it should be remembered, that for thousands of years, man has been acquiring information by the slow and

laborious method of "trial and error" and applying this information to his methods by the process of the "rule of thumb". Astonishing as has been the advance from this position within the past century, it must be obvious that the comparatively short study of modern times cannot possibly be expected to have thoroughly elucidated, considerations of modern developments apart, even the phenomena observed, and methods developed, during those thousands of years. In no branch of study is this more apparent than in Agriculture, the most ancient of the arts, and the most complex of the sciences. In no science has so much been learnt in a short time, or so little relative progress been made in comparison with the information acquired. This is not surprising, when we reflect that in the growth of any plant are involved considerations of plant physiology and heredity, physical conditions (soil texture, temperature, water, air and light supply), chemical problems of soil reaction and plant food (themselves involving questions of bacteriological, protozoological, and fungal changes), with extraneous modifications occasioned by diseases and pests of the plant. Difficult as is the study of any single one of these aspects, the correlation of all of them essential to the full consideration of any Agricultural problem, must be still more so, especially as the undue or insufficient stressing of any one aspect may profoundly modify the conclusions to be arrived at. The information to be obtained by the study of any one only of the above mentioned aspects is limited, and it is the limitations of the ordinary routine chemical examination (or analysis) of soil, that it is intended to discuss in this article.

By "soil" is generally understood any exposed portion of the earth's surface which will support the growth of the higher plants. It consists essentially of two classes of materials, disintegrated rock, and "organic matter" or plant and animal debris: variations in extent of disintegration of the former, and the chemical changes it has undergone, and in the

amount of modification of the latter, determine the resulting type of soil, which, as is well known, may vary within very wide limits. Nevertheless, the essential components are the same in all cases, and it is their relative proportions, climatic conditions apart, which determine the extent of the ability of the soil to support plant growth. It is with the determination of the said relative preportion that chemical analysis is concerned.

The chief components which influence plant growth in any way, and with which the analyst chiefly concerns himself are :—"Organic matter" (containing essentially nitrogen, carbon, hydrogen, and oxygen). Sand, (and other matters insoluble in strong acids) Iron, Alumina Lime, Magnesia, Potash, Soda, Sulphates, Carbonates Phosphates, Chlorides (sometimes).

The results of a typical so-called "complete" analysis of cane soils of this colony are set out below, as an example

	Total	Available to 1% Citric acid.
Water	3.50	
Loss on ignition (chiefly organic matter*)	8.12	
Sand and insoluble	73.58	
Iron oxide	4.51	
Alumina	8.98	
Lime	.20	
Magnesia	.50	
Potash	.21	
Soda	.20	.020
Sulphuric acid	.08	
Phosphoric acid	.09	.010
Carbonic acid	nil	
Hydrochloric acid	.03	
	100.00	

* Containing Nitrogen .25

Of these substances, the materials directly essential to plant growth are the nitrogen, potash, phosphoric acid, lime, magnesia, iron and sulphuric acid, though the cases where the soil does not contain a sufficiency of lime, magnesia, iron or sulphuric acid for the requirements of any crop being rare, the first three ingredients may be regarded as the real essentials. All others are of indirect interest only; their respective rôles are often more or less imperfectly understood, though often of predominant importance; a consideration of them is outside the scope of this article.

Now an inspection of the above soil (or preferably a "mechanical analysis" showing the relative proportions of particles of different diameter) will have shown the analyst that the soil is a fairly heavy clay, and from his previous experience of such soils, he is able to say from the chemical results above that this is a soil of distinct potential fertility (*i.e.* it can produce substantial crops of various cultivated plants for a considerable period, given reasonable husbandry and climatic conditions). He might be a little doubtful about the lime content especially as it is less in amount than the magnesia; he might also reasonably doubt the ability of the phosphoric acid to hold out over a long period; a determination of the so-called "available" proportion of these substances mentioned below would help in some respects, but unless the analyst had already had information of the behaviour of that particular class of soil under the conditions and crops under which it was proposed to work it, he could not with confidence state that such and such was the best method of treatment, or of manuring.

Now suppose a crop of say sugar cane is grown on this particular plot of land, and assume that the roots of the cane feed on only the upper 18 inches of soil; assume also that an acre of this soil to that depth weighs 3,000,000 lbs.; there will then be present in this amount of soil 7,500 lbs. of nitrogen, 6,300 lbs. of potash, and 2,700 lbs. of phosphoric acid by the above analysis. (Even this does not represent the whole as there is still present some potash at any rate in the "insoluble" portion.) The amounts "available" to citric acid will be, potash, 200 lbs., phosphoric acid

100 lbs. Now, if in cultivation a crop of cane were obtained of, say, 40 tons per acre, it would, according to analyses by Stubbs in Louisiana, remove in the whole crop, canes and leaves, about 40 lbs. of nitrogen, 90 lbs. of potash and 60 lbs. of phosphoric acid, that is between 1 and 2 per cent. of the total amount and 60 per cent. of the "citric acid available". On the face of it this would seem to the lay mind to indicate that there was no need to apply any manure of any kind to obtain a crop of this magnitude; yet we know from experience, that in actual cultivation, this soil would, if left unmanured, probably not give us more than about 10 tons. The explanation of this is, that the plant is not able to use the major portion of the material the analysis records as being present; only a quite small proportion of the plant food in any soil is in a condition to be directly used by the plant, and it is largely on the rate at which the stored-up materials become available that the productivity of the soil depends. The difficulty of ascertaining this rate will be realised when one notes that the analyst obtains his amounts of plant food from the soil by dissolving it out with concentrated acids, usually at high temperatures; moreover, his results will vary according to the strength of the acid he employs, the temperature he uses, and the duration of time over which the acid is allowed to act on the soil. Now the plant has neither strong acid, nor high temperature, at its disposal, and moreover takes months in abstracting from the soil the materials it requires. It does not require much reflection to appreciate that there will be substantial discrepancies between the analysis made by the analyst and that made by the plant. Herein lies the difficulty of the whole matter. The exact manner in which the plant dissolves out the mineral ingredients at any rate, is not as yet thoroughly understood, and the difficulty of simulating, in the short time at the analyst's disposal (hours or days) what the plant effects slowly over a long period, has so far proved insurmountable. Many attempts have been made to do this, the most successful of which was by Dyer, who, in 1894, estimated the acidity of the roots of a large number of plants, and finding it to be on the average

about equal to a one per cent. solution of citric acid, used this latter solution to digest soils for a considerable number of hours: the amounts of mineral constituents he extracted in this way he considered as immediately available to the plant, and found that his results were borne out by the cropping figures of the soils of the Rothamsted and other experiment stations. The method seemed at first sight simple and alluring, but it has since been found that the acidity of the root sap has very little to do with the solution of the mineral ingredients, and that far from being simple the reactions involved are hedged around with numerous complications, a consideration of which would be out of place here. Nevertheless the method has proved to be of considerable value when used in connection with manurial plots and is practically in world-wide use. Other investigators have used different solvents such as dilute hydrochloric and nitric acids, aspartic acid, ammonium citrate, and so on, but to no particular advantage. Even in this method, however, it is impossible to draw general conclusions, for different crops require different amounts of mineral ingredients, and different soil reactions, and inferences drawn from one crop would probably fail with another.

About 1890 several German investigators, losing faith in the abilities of chemical analysis to give information as to manurial requirements, instituted the method of "pot culture" in which crops under inquiry are grown for longer or shorter periods in pots containing the particular soil about which information is required, using different methods of manuring: in short a condensed series of manurial trials. The method, however, proved too cumbersome and was not directly applicable to field conditions, and though of great value in studying soil problems, pot culture is not now used in the routine of soil "analysis."

The question the practical man requires an answer to, from the analyst, is, "what manuring does my soil require *now* to give me the best results at the least cost"? and it is, with this in mind that the subject is being discussed here, for after all, that is all the majority of practical men are interested in. With analytical methods only at one's

disposal a definite answer cannot be given to this query. The only really reliable information is that obtained from actual field trials on the particular class of soil under inquiry in which varying amounts of different manures are applied and their results on crop production accurately recorded from year to year. It is in connection with these field trials that analysis is of the greatest value in the light of the question we are considering. When definite results have been obtained from field trials on the broad general types of soil in any given country or district, and analyses have been made of the soils of the plots from time to time, then definite advice can be given on the handling of any particular field elsewhere by sampling the soil on it, comparing its analysis with that of the manurial plots about which we have accumulated so much information, and by means of this comparison, advising in the light of the results obtained on the particular type of soil in the field experiments. In the most progressive countries the agricultural districts are being mapped off by "soil surveys" into areas of the different soil types, classified according to the results of chemical and mechanical analysis, and experiment stations established on those types of sufficiently large area to warrant it. The correlation of any particular field with the fields of the plot trials is then established by analysis, and the advisor thus placed in a really sound position to advise on treatment. The matter is not of course as simple as this statement might make it appear: it is the *principle* only that an attempt here is being made to explain.

Cases of pronounced infertility are a much simpler matter and here the ordinary chemical analysis is on much safer ground: these cases usually result from the marked absence of some plant food, or from some pronounced reaction of the soil, or presence of an injurious factor. These can almost always be traced.

It would be as well to point out here that information obtained from plot trials may not be indispensable where an analyst has been working for some years with soils of one or two different types and has been at the same time

able to follow up the performances of these soils in the field. Here his long experience will serve him : he has in fact been accumulating during those years of experience precisely that information which the plot trial is designed to give in greater detail. Unfortunately, however, this experience is often of a nature that cannot be recorded in terms of words and figures, while the statistics of the experiment station plots are at all times available to others.

To recapitulate then :—

Chemical analyses of soils alone, can, in the present state of our knowledge, tell us whether a soil is, or is not, fertile : i e., capable, with reasonably good husbandry and climatic conditions, of supporting crops of plants of value to man, for an indefinite period. This information is ordinarily of value only to an agriculturist taking in virgin and or entering on operations in cultivated lands of which he has no previous experience.

It can usually elucidate cases of pronounced infertility in apparently fertile lands.

Its greatest value directly to the everyday operations of the practical man is usually in conjunction with field trials, for in this way only can really reliable information be given about such problems as manuring and general cultivation.

SOME RECENT ENTOMOLOGICAL SURVEYS BEARING ON MALARIAL INCIDENCE IN BRITISH GUIANA.

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(*A paper Read before the West Indian Medical Conference held in B. Guiana, July,* 1921.)

The Biological Division of the Department of Science and Agriculture since its inception in 1911 has, from time to time, made studies of the various species of the malarial transmitting mosquitoes of British Guiana, their habits and breeding places.

Recently, on the suggestion of the Surgeon General and the Director of Science and Agriculture, mosquito surveys of a number of sugar estates and other areas in different parts of the Colony have been made with special reference to the breeding places of Anopheline mosquitoes.

The technique employed is based on experience gained locally, and from practices evolved by other investigators in different parts of the world.

In making an examination of a sugar estate, for instance, a plan of the residential areas of the estate showing also the various irrigation, drainage and water navigation schemes is, if possible, obtained.

All these various areas of water are then carefully examined for mosquito larvae by the well known "dipping" method.

For dipping a white enamelled soup ladle of medium size is utilized. Samples of the water to be examined can by this means be conveniently secured and the white background renders the observation of any larvae or pupae that may be present an easy matter.

Frequent samplings of the water among grass, other vegetation and many places which experience has shown to

be probable lurking places for mosquito larvae will give an accurate idea as to the number and species of larvae present.

In making an examination of a part of any particular piece of water never less than twenty-five to thirty dippings are made. If no larvae are then obtained the results are *marked negative.*

Any larvae or pupae obtained are transferred to glass tubes loosely plugged with cotton wool.

Development is *allowed to proceed and the adult* mosquito eventually secured. Field notes are made on the spot. The identification of the adult mosquito is made in the British Museum through the Imperial Bureau of Entomology.

A plan of the Estate is finally made indicating the various breeding places of mosquitoes, with particular reference to Anopheline areas.

With regard to the breeding places of Anopheline mosquitoes on sugar estates and the species concerned some interesting results have been secured.

So far only one species of Anopheline mosquito has been taken; it is the well known ***Anopheles tarsimaculata.*** Goeldi. Indeed, this appears to be the prevalent species of Anopheles throughout the coast lands of British Guiana.

Its breeding places are invariably shallow, grass-grown drains well shaded from the direct rays of the sun. I have never found the larvae in any except comparatively clear, fresh water.

At Pln. Blairmont in Berbice, where the first mosquito survey was performed, numbers of the larvae of this particular Anopheline were taken in the small drains in the cane pieces surrounding, and in close proximity to the residental areas of the estate. The canes had attained a height of eight to nine feet and consequently ample shade was provided. The drains were grass grown and contained almost clear water.

A most dangerous association was thus brought to light—to wit—a fruitful source of Anopheles mosquitoes within a hundred yards of the manager's house, the

overseers' quarters, the estate's hospital and the dwelling ranges of the estate's work-people.

This survey was executed during dry weather, in the wet weather the breeding facilities of this mosquito would be greatly widened.

Similar associations were revealed during the examination of other estates. In one instance a large ornamental and vegetable garden attached to the manager's house was found to contain a number of active Anopheline breeding places in the shape of small grass-grown drains and in some larger drains partially obscured with vegetation.

In another instance the small drains in a sugar cane seedling plot were similarly implicated.

On every estate so far examined Anopheline breeding areas have been detected in close proximity to the inhabited portions An examination of the various estates, hospitals malarial statistics bear witness to the result of such associations.

The Potaro District in British Guiana, some three days' travel from the coast lands, has for many years borne an unenviable reputation for a particularly malignant form of malaria.

Early this year I was deputed to make a mosquito survey of the district and some interesting points were brought to light.

From my pretty wide experience of the forest area of this country I can positively state that it is an exceedingly rare event to encounter an Anopheles mosquito within such areas.

Prior to my Potaro survey* I had previously, in one place within the forest only, known Anopheles mosquito to occur. I allude to Rockstone, the terminus of the Wismar—Rockstone railway. During almost every visit that I have made to this place, I have both observed and been bitten by Anopheles mosquitoes. I may add that this place has, in the past, possessed a sinister reputation for malaria.

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*Report on malarial mosquitoes in the Potaro District printed in this number of the Journal under "Plant Diseases and Pest Notes."—G.E.B.

I was, therefore, much surprised to find Anopheles mosquitoes to be common in certain parts of the Potaro District. At the so-called 10 miles it was the common species. Specimens submitted to the Director of the Imperial Bureau of Entomology have been identified as *Anopheles agryritarsis*, R.D. I did not secure a single specimen of *Anopheles tarsimaculata*, Goeldi. in this district.

Larvae were discovered in old tins covered with vegetation and containing water kept fresh by rain drips from the surrounding vegetation. The annual Potaro rainfall consists of some 150 inches.

This district is one of empty tins, flasks and bottles due to its distance from civilized centres, and the necessity of carrying food and beverages in such receptacles. So the Anopheline and other species of mosquitoes are ever well provided with suitable breeding places.

Another dangerous association was brought to light here and this was the presence of a clear, grass-grown stream containing many Anopheline larvae in close proximity to the local hospital.

MEMORANDUM ON THE FALLING OFF IN THE NUMBER OF CATTLE SINCE THE YEAR 1916.

1. The returns of the numbers of cattle on the Coastlands of the Colony as shown by the yearly Agricultural Census during each of the years from 1912, a year of intense drought which resulted in a very great diminution of the cattle in the Colony especially of those of the County of Berbice, have been carefully revised by the Director of Science and Agriculture and are as follows:—

YEARS.	CATTLE, HEAD.
1912	66,000
1913	75,240
1914	79,500
1915	87,760
1916	93,264
1917	86,663
1918	77,108
1919	79,614
1920	85,936

Experience has proved that such returns as the above are subject to error in excess or in deficit of approximately 8% to 10% in each year. Making such an allowance the figures indicate a steady increase in the number of cattle in the Colony from the year 1912 to 1916. A marked falling off in the years 1917 and 1918 and a gradual increase from the latter year to the present time.

2. It is a somewhat difficult matter to compare these records with those of other places but published records of the United States and of Canada covering 40 years during which the number of cattle under report increased from 22,700,000 to 80,545,900 may be used for this purpose. If the cattle on the Coastlands of British Guiana had increased at the same rate as those in the North of America did the following would have resulted.

YEAR.	NO. OF CATTLE BY CENSUS.	NO. OF CATTLE ESTIMATED.
1912	66,000	66,000
1913	75,240	70,158
1914	79,500	74,578
1915	87,760	79,276
1916	93,264	85,290
1918	77,103	95,222
1919	79,614	101,221
1920	83,938	107,397

3. It is evident from the above that the rates of :rease indicated by the Census returns from 1912-1916 re considerably higher than those of the North nerican Countries. If the cattle on the Coast-lands d continued to increase from 1912 to 1920 at the erage rate they did from 1912 to the end of 1916, e number of head at the end of 1920 would have en in round figures 137,760. The cattle on the ast-lands are now in round figures 51,800 less than ey should have been if the 1912-1916 rate of :rease had continued and 23,460 less than if they d increased at the Northern rate. Even if the ,108 head of cattle returned as present on the ast-lands in 1918 had increased at the 1912-1916 e to the end of 1920 they would have been at cember 31st, 1920, 93,300 or say some 9,300 more an were returned at that date.

4. Without doubt this depression in the rate of :rease in the herds of cattle is due to several causes me of which are beyond our control but an portant one which should be controlled is the liscriminate slaughter of milch cows and promising ung heifers. The following records have been tained by the Government Veterinary Surgeon d the Director.

RETURNS OF SLAUGHTERINGS AT THE ABATTOIRS AND BUTCHERIES FOR THE YEAR 1919.

	GEORGETOWN ABATTOIR.	NEW AMSTERDAM ABATTOIR.	COUNTRY BUTCHERIES.
Bulls, oxen and steers	4,199	536	2,092
Cows	1,857	189	783
Heifers	567	79	383

RETURNS OF SLAUGHTERINGS AT THE ABATTOIRS AND BUTCHERIES FOR THE YEAR 1920.

Bulls, Oxen and Steers	4,796	658	2,488
Cows	1,849	291	1,046
Heifers	373	62	384

The totals are as follows:—

	1919	1920	1919 & 1920
Bulls, oxen and steers	6,827	7,942	14,769
Cows.	2,820	3,186	6,006
Heifers	1,029	819	1,848

5. The records of the Georgetown Meat Inspector show that of 2,050 cows slaughtered 77 were of promise as future milchers, whilst ot 790 heifers slaughtered 200 showed promise of becoming good milch cows. These figures are equal to 3.7 and 32.4% respectively. It may be safely assumed that of the 3,000 cows slaughtered annually 110 were potentially good milchers, whilst of the 924 heifers slaughtered at least 300 would, if not killed, have become good milch cattle. In round figures at least 400 Milch cattle are thus lost to the Colony each year. The slaughter of the heifers and young cows, each of which might have become the parent of say three heifers, results in actual and potential loss to the cattle industry of 1,600 milch cattle per annum.

There are not any figures available indicating how many productive Milch Cattle are among the cows slaughtered but it appears probable that the great majority of the cows slaughtered are sterile either from age or from physical defects.

6. Neither export, the extension of the Rice industry, nor any disease of the cattle can account for their lessened rate of increase during recent years and hence control over the slaughter of cows and heifers appears desirable. Such control is strongly supported by the following statement from the records of the Georgetown Abattoir.

Proportion of cows and heifers to total cattle slaughted from the year 1914 to the year 1920.

YEAR.	PER CENT.
1914	16·1
1915	19·6
1916	20·4
1917	26·3
1918	44·1
1919	36·4
1920	27·6
1921 1st Quarter	33·1
1921 2nd Quarter	32·1
July	43·3

The Stabroek Butchery Co., Ltd., in a letter to the lovernment has represented that in its recent slaughtering he proportion of female to male cattle has been 60 per ent.

7. The proportion, 36.1 per cent. of cows and heifers mong the cattle slaughtered in New Amsterdam and in he country districts during the years 1919 and 1920 has een higher than the average rate during the same period, 2 per cent., in the Georgetown Abattoir as is shown by ie following :

1919	Cattle Slaughtered.	Cows and Heifers Slaughtered.	Proportion of Cows and Heifers to cattle slaughtered (per cent.)
ɜw Amsterdam	795	259	32.5
›untry Districts	3258	1186	36.4
1920			
ɜw Amsterdam	1011	353	34.9
›untry Districts	3918	1450	77.0
Total ...	8982	3248	36.1

J. B. HARRISON.

AGRICULTURAL NOTES.

Selection of Seed—Coconuts—Nurseries.

On a Coconut Plantation two things are essentially necessary, i.e. the Selection of nuts for seeds and the proper maintenance of the Nurseries. Only such nuts that are quite ripe and that have naturally dropped from the trees should be chosen. Picked nuts are never completely mature and should be rejected.

The Planter who has the advantage of selecting the dropped nuts at the foot of the tree, should choose the following :—

1.—Nuts, having as nearly as possible a spheroidal shape with a slight depression at the base. These nuts vary from 8 to 9 inches in length and 7 to $7\frac{1}{2}$ inches in width and 24 inches in the larger circumference. When husked they are also spheroidical in form and very big in size, divided lengthwise they are $5\frac{1}{2}$ inches long and $4\frac{1}{2}$ inches wide, the meat (albumen) is $\frac{3}{4}$ to $\frac{7}{8}$ ins. thick—these are the nuts which obtain the highest market rate in the United States.

2.—Oblong shaped coconuts with a swelting towards the centre—they are generally 9 to 10 inches long and 7 to 8 inches in width. When husked, they present an elliptic form 5ins. by 6 ins.

The choice of the above shaped nuts is easy when it can be done on the estate, but when seed nuts are bought and all sorts are to be selected from, care should be taken to husk some of the cocounts, examine their form and their meat and give the preference to the round-shaped and well formed ones. Choose those with a thin "coir," unless the manufacture of coconut fibre is intended. When selecting nuts for seeds, it is best to pick out those that have dropped from vigorous and healthy trees, about 20 years old and are heavy bearers and yield fruits of good quality.

As a general rule, only heavy nuts, indicating that they contain water should be chosen ; this is easily disclosed by shaking.

As a last advice, reject such nuts which show round the "point of attachment" a bronze or black colour which differs from the colour of the nut itself and which indicates traces of mildew. These nuts are certainly unsound and have been picked before they were ripe. Always chose nuts of a uniform colour, regular in shape and having a smooth skin (epidermis).

NURSERIES.—After the careful selection of the seed-nuts has been made, a proper site for the nursery should be marked out. A uniform and level piece of fertile land—a sandy loam preferred—should be prepared and should be large enough for the number of coconuts *it is intended to plant.*

This site should be as near as possible to the main buildings of the estate, so that it can be easily attended to and kept quite free of weeds at all times.

6 to 8 drills parallel and near to one another should be opened in proportion to the number of nuts to be sown. On either side of those 8 drills a small interval should be provided in the centre of which a canal will be dug to bring in water and facilitate the watering of the young plants.

The coconuts are to be planted in the drills two or three inches apart and buried to the level of the stem-end and no more—they must be covered with some grass or straw, to protect them from sun and ensure a regular germination.

Coconuts should be planted vertically, this will cause the trees to grow quite straight and they will be less liable to be affected by the action of the wind. It is a mistake to plant coconuts in the same manner that they drop from the tree, because the seed bud pierces the husk horizontally and once it has burst out, it rises vertically

and this compels the young shoot to take a curve-like inclination and when the tree has attained the height of 20 or 25 feet, it will bear the effect of the wind with difficulty and will be exposed to be easily uprooted.

When or at what time should Nurseries be made? There appears to be no special time for doing this but it is preferable to start them shortly before the wet season sets in, because at that period, vegetation, which had lost some of its vigour after the great heat of the dry season begins to regain its strength and the nuts will germinate under good conditions to benefit by the advent of the first rain.

It is a very common belief in some quarters, that coconuts planted during the three days preceding or the three days following the New Moon, grow more healthy trees and it is even claimed that such trees live much longer. The conclusions arrived at as to the correctness of this assertion are yet vague and undetermined.

From the time it falls from the tree when it is considered to be fully matured, a coconut requires 12 to 15 weeks to germinate. If it happens that the germination period extends much beyond that time, this indicates that the seed-nut was not quite ripe and the seedling will not become a good and healthy tree.

Shade is not always required when establishing Nurseries. In the sandy soils of the Colony where moving water is met at two or three feet below the surface it is not needed—in fact, too much shade under those conditions will cause the seedlings to grow slender and they will not resist the wind. In stiff soils, liable to suffer from drought, shade would be advantageous and could be supplemented with banana plants. As a rule the shade resulting from the coconut themselves is generally sufficient for the needs of the young plants. Sight must not be lost of the fact that the action of the sun's rays is beneficial to coconuts.

Coconut Nurseries should be protected from the wind. If the site is much exposed to wind, a wind belt would become necessary. The "Wild Coffee" or "Cashew Nut" form good wind belts.

TRANSPLANTING.—After remaining in the Nurseries 12 months, the young seedlings can be transplanted, they will then be 2 or 3 feet high. They must be removed with a spade and all the rootlets that have burst out and are protruding from the husk must be cut with a very sharp instrument. When thus prepared, they can be carted or carried to the spot where they are to be planted without risk of injuring them.

The field to be planted should be properly cleaned or weeded and carefully lined. Stout stakes 3 to 4 feet long pointed at one end should be driven 3 or 4 inches in the ground with a mallet, at a distance of 25 feet apart. The lining must be symmetrically carried out, so as to obtain straight and long rows. Once this is done, the field is ready to receive the young plants.

A hole is dug near the stake, deep enough to allow the nut to be planted to such a depth that the top of the husk just projects above the level of the soil. If the seed-nut was completely buried, it would be exposed to the ravages of such insects like the "rhinoceros beetle" which would enter through the eye, at the point of attachment, and cause serious damages to the seedlings or destroy them.

For more reasons than one, 25 feet apart would seem tobe the right distance to plant coconuts.

1.--More a tree of the size of the coconut palm, has of space and air, the better this will be to permit it to extend its leaves (fronds), by which much of its food is absorbed from the air and to grow luxuriantly and to become a heavy bearer of good sized fruits. The fronds

or leaves of the Coconut attain lengths of 12 to 15 feet at a nearer distance than 25 feet, the leaves would get entangled and deprive the plant of light which is an essential factor to its growth, it would grow up thin and slender and yield small fruits.

2.—Like all other plants, coconuts are liable to diseases. At a distance of 25 feet apart it will be more easy to isolate a plant attacked by bud-rot or some similar contagious disease and control the harm that can be done by destroying one or two trees—at a near distance, it is most likely that many more trees would have to be destroyed.

3.—When a Coconut plantation is symmetrically lined at equal distances at 25 feet, the work of gathering the crop and transporting it is facilitated.

From the proceedings of the Agricultural Society of Trinidad and Tobago, May, 1921.

ANNUAL REPORT ON THE WORKING OF THE BRITISH GUIANA SUGAR PLANTERS EXPERIMENT STATIONS' COMMITTEE FOR THE YEAR ENDING SEPTEMBER 30, 1920.

TO THE CHAIRMAN AND MEMBERS OF THE COMMITTEE OF THE BRITISH GUIANA SUGAR PLANTERS' EXPERIMENT STATIONS.

15th January, 1921.

GENTLEMEN,

Many efforts have been made in the past by the sugar planters of British Guiana to establish an experiment station scheme to continue and augment the classic investigations on sugar cane carried out by Professor Harrison at the Botanic Gardens, where the area of land and funds available have long been inadequate. All

these schemes fell through by reason of the failure of one or of a few estate proprietors to co-operate with the remainder. The Sugar Planters' Association finally decided to approach the Government with a view to resorting to legislation as a means of compelling all proprietors to co-operate in establishing an experiment institution. The Government having agreed to assist in this way, a permanent Committee was finally appointed by the Sugar Planters at the former's request, consisting of six members of the Association connected with sugar estate working, under the Chairmanship of Professor J. B. Harrison (who as Director of the Department of Science and Agriculture was appointed *ex officio*), to make all arrangements relating to the scheme, and with authority to make whatever appointments were considered necessary. This Committee met for the first time on June 30th, 1919, and consisted of Professor Harrison (Chairman), with Messrs. R. Strang, W. M. B. Shields, A. E. Bratt, J. C. Gibson, A. E. Craig, and R. E. Brassington. A draft Ordinance was discussed by this Committee in August and was finally passed by the Government on September 24th, 1919. This Ordinance (No. 29 of 1919) is termed "the Sugar Planters' Experiment Stations Ordinance, 1919" and was published in the "Official Gazette" of 30th September, 1919.

The Committee having first assessed the contribution of the estates to the fund for the current year at 33 cents per acre, proceeded to the appointment of a General Manager or Superintendent of the prospective stations. The post was offered to a previous applicant, Mr. W. W. Taggart, Assistant Director of the Louisiana Experiment Station. Mr. Taggart finally declined the offer for family reasons. The post was then offered to Mr. J. Crabtree of the Woburn Experiment Station England, and accepted by him. Mr. Crabtree arrived in the colony and assumed his duties on 4th April, 1920.

In the meantime the Committee decided at once to start a central station in or near Georgetown with a view to extending as rapidly as possible the promising varieties of cane then in cultivation in the Botanic Gardens which

had not had trials under estate conditions, and thus to lose no time in the search for, and production of, new varieties, this being regarded as one of the most urgent requirements of the sugar industry. Accordingly a piece of land in juxtaposition to the Botanic Gardens was surveyed by the Committee in December and leased for a period of ten years. This land was a portion of the western half-section of Plantation Sophia, an abandoned sugar estate owned by Messrs. Curtis Campbell & Co. This estate had been in cultivation from early times till 1891 when it was abandoned owing to factory troubles and heavy cost of sea defence. When in cultivation it grew heavy crops of cane; it was seen also to be well adapted for the purpose of a seedling nursery as the soil varied in texture from the typical heavy Demerara clay in the front of the estate to a somewhat lighter "medium" soil in the middle, with a typical sand reef cutting through at the back. This variation will give an opportunity for the seedlings raised being selected for their performances on these different classes of soil, which it had not previously been possible to do at the Botanic Gardens where the soil is all heavy. A 35 acre portion was first taken but was later increased to 51 acres so as to include a whole half-section: still later the eastern half-section was added, an area of about 60 acres, so that the whole amount now available is approximately 110 acres. During the 25 or so years of abandonment, a thick growth of bush and trees had arisen, particularly on the medium and lighter lands, the predominating species being:—

Trees	*Common name*
Mimosa asperata	
Cecropia peltata	Trumpet wood
Psidium pomiferum	Guava
Mangifera indica	Mango
Cordia umbraculifera	Clama cherry
Pithecolobium saman	
Inga dulcis	Whykee

Shrubs	*Common Name*
Flemingia congesta	Black sage
Cordia Aublettii	
Cassia bacillaris	Sweet sage
Lantana camara	Bastard jamoon
Ardisia humilis	
Palms	
Elaeis guineensis	African oil palm
Herbaceous	
Andropogon sp.	
Sporobolus sp.	
Cyperus sp.	
Desmodium incanum	
Clerodendron sp.	
Heliconia acuminata	
Climbers	
Securidaca volubilis	
Canavalia ensiformis	
Paullinia sp.	

The trenches were filled with a compact growth of Mucca-mucca.

Mr. J. P. Bastiaans was appointed field manager in February and a commencement then made with the clearing of the fields and dams and with the excavation of the trenches. By June the navigation and side-line trenches had been completed at a cost of $3.24 and $1.87 per rod respectively, and about 11 acres in the centre of the area cleared and half-banked ready for planting. A building comprising manager's office, watchman's house, and labourer's logie, had meanwhile been erected on the mid-walk dam, and a lift-up bridge constructed over the Lamaha Canal connecting Sophia with the Experimental Fields of the Botanic Gardens: the costs of these were respectively $1,561.86 and $632.26. The Station was then formally

opened on June 21st by His Excellency the Governor in the presence of a large attendance of people connected with cane sugar production. His Excellency planted the first cane tops and transplanted the first basketed seedlings on the Station.

In July and August the large number of different varieties of cane growing in the cane fields of the Botanic Gardens were cut and the whole of the tops available planted out at Sophia with the object of extending as rapidly as possible these varieties (already selected for performance in the Botanic Gardens in previous years), and trying them out on a larger scale and under different conditions. 640 varieties were thus obtained covering about 11 acres, in addition to about 2,000 selected seedlings raised in 1919. The areas of the varieties vary from a sixth of an acre down to single stools. Those occupying the larger areas will probably be drawn down in April 1921 for distribution to the estates for further trial there, the smaller will be drawn down and extended at Sophia at the same time: this refers, of course, to the promising varieties only. It is not proposed here to give a list of the seedlings planted out, as, until records of their performances are available, such list would be merely a more or less meaningless array of numbers.

Meanwhile the raising of new seedlings from arrows is being pushed forward both in the Botanic Gardens and at Sophia. They have been perforce obtained from arrows of seedlings now in general cultivation, and the arrows used have been collected from the estates. It has been noticed, however, in previous years that more promising seedlings are often obtained from arrows of the old named varieties, and in consequence special attention has been given to planting out as complete an assortment of these varieties as possible, for the sole purpose of obtaining arrows for raising seedlings in ensuing years.

The Superintendent has put himself in communication with the Experiment Stations in other sugar cane growing countries, and many of these have kindly

omised to send tops of their most promising cane rieties for trial in Demerara, a few of which have ready been received. Several stations are issuing no ne at all owing to the incidence in their plots of the Mosaic " disease mentioned below.

A collection has been started also at Sophia, of ecies of legumes or other vigorous plants with the ject of finding one of possible value as green manure. me indigenous species have already been obtained d other kinds are being imported. It is intended to tain as complete a collection as possible so as to leave stone unturned in this regard as the matter will be considerable importance in the renovating of old cane ads.

It will not be possible to commence any manurial other plot trials at Sophia while only small batches seedlings are available, and the area is, as now, a mplicated pattern of a large number of different rieties. It will, moreover, be necessary first to reduce, taking off a few crops, the accumulated fertility of e soil produced by the 25 years' growth of bush upon it the conditions are to be, as is necessary, similar to ose under which cane is grown on the estates. For the irpose of manurial and cultural trials it is proposed to tablish branch stations on the estates, in different parts the colony, where these trials can be carried out under ate conditions and on the estate soils. This applies so to trials with mechanical tillage, which at Sophia uld not at present be representative owing to the tangle trees and bush roots in the soil, and to the original yout of the estate in very small beds which it is not orth while at present to alter. The location and organi- tion of these sub-stations are now under consideration the Committee. A small pamphlet, written by the iperintendent, was issued by the Committee in May, d distributed among the estates, describing the mptoms of the new Mosaic disease which has been reading consternation among the cane growers, and ivoc among the crops, in several cane growing countries.

The cò-operation of all planters has been requested i reporting any suspected cases, early and vigorot elimination being necessary in the control of this diseas It is intended to circularise the estates in a similar wa in regard to any new points which arise, of importanc and interest to cane planters.

The Superintendent has, from time to time, visite the estates as opportunity has arisen, with the object c studying the present conditions of the cane industry i the colony. 21 of the 37 estates have been visited so fa and a complete tour will be effected in due course. A a result, a report dealing with these conditions and discussion of the possibilities of development and in provement is being written.

Pending the acquisition of a laboratory and staff b the Committee, the Government, through Professc Harrison, has kindly placed the laboratories of tl Department of Science and Agriculture at its disposa Professor Harrison has also permitted the Superintende to establish his office in the same buildings where als the Committee's meetings are held.

The balance sheet for the working of the financia year is submitted in the following two pages. It is necessa here to point out, the greater proportion of money expende has been in bringing new land into cultivation, and cannc be regarded as expenditure on actual experiment work also the costs of clearing and cultivation at Sophia hav been considerably greater than in estate work, due to tl heavy nature of the bush cleared, the large amount c roots which could not be left to rot in the usual way, t difficulty in obtaining suitable labour at reasonable rate and to the superintendence and multiplication of labot necessary in the cultivation of large numbers of sma plots.

In view of the continuing heavy costs of establisl ment, the Committee at their September meetin recommended that the contribution of the estates for tl

ending September 30th, 1921, be assessed at $1.00 ıcre: this was sanctioned by the Sugar Planters' ciation in the same month.

In September also, the three retiring members, srs. Strang, Shields, and Gibson, were re-elected by Planters' Association, so that the personnel of the ımittee remains unchanged for the forthcoming year.

JAS. CRABTREE,
Superintendent.

LABOUR COSTS AT SOPHIA.

ıring Dams	$ 316 44
ıring Mucca-mucca from trenches	573 44
ging navigation	1,852 28
ging side-line (including removal old aqueduct. $343.28) ...	1,015 18
ging cross canals and backing earth	395 40
ıring fields of bush 18½ acres	474 91
„ „ „ trees „ „	441 72
ging drains, 17½ acres	182 94
ing	106 16
f Banking, 17½ acres	766 80
nting 11 acres	658 12
king banks twice, 13½ acres	410 76
eding 5 times, 17½ acres	658 73
ınsporting	515 26
perintendence	384 09
ıtchmen	187 42
rpenter	177 96
ndries	344 46
	$ 9,462 07

British Guiana Sugar Planters' Experiment Stations Committee.

STATEMENT SHOWING TOTAL RECEIPTS AND EXPENDITURE FOR YEAR ENDING 30TH SEPTEMBER, 1920.

Receipts.		Payments.	
Assessments on Sugar Estates	$21,954 24	Chairman	$ 889 73
Government contribution in lieu of assessments on cane farmers	300 00	Secretary	500 00
Refunds on motor car (Superintendent)	250 00	Assisant Secretary ...	300 00
Interest on Savings Deposit	52 50	*Superintendent*, Salary	1,888 00
		House	295 00
		Motor car	1,200 00
		Travelling	177 00
		Passage to Colony	470 00
		Field Manager, Salary	931 02
		Travelling	232 76
		Field Overseer ...	84 00
		Sophia Station— Wages	9,462 07
		Rent six months	250 00
		Office Buildings	1,779 86
		Boats	137 06
		Bridge	632 26
		Roadway	50 00
		Sundries	616 03
		Total payments	$19,894 79
		Balance in Colonial Bank, current ac.	111 45
		Balance in Colonial Bank, Savings deposit	1,052 50
		Balance in Colonial Bank, Superintendent and Secretary Account	1,498 00
Total	$22,556 74	Total	$ 22,556 74

PLANTS WORTH KNOWING.

By J. F. Waby.

Bomarea edulis, a native of Trinidad, a very pretty nd useful scandent herbaceous, soft-wooded plant ith somewhat the appearance of *Gloriosa superba*, rowing to about 5 feet 6 inches to 6 feet high, with any pipe-like stems which twine rather than cling, here being no tendril at the end of the foliage, the rowth being closely centred rather than spreading as oes the *Gloriosa*. Stems $\frac{3}{16}$ inch thick, soft, pale green, oliage pale green almost sessile, what stem there is eing twisted, lanceolate, acuminate, 5 inches long, one nch wide at the widest part, midrib prominent above, everal closely running parallel veins on either side, et $1\frac{1}{2}$—2 inches apart on various sides of the stem. nflorescence at point of growth, where there are several eaves formed in a whorl, above which radiate 6 flower talks rather larger than whipcord, of a slightly rownish tinge; these are $3\frac{1}{2}$ inches long to the first owers where there is a small lanceolate green bract; he second branching is a little shorter and the third horter still; the flowers are borne solitary, each peduncle eing $1\frac{1}{2}$ inches long; ovary small, green; the individual lowers are $1\frac{1}{2}$ inches long, with a spread at top of $\frac{3}{4}$ inch; omposed of 3 outside, pink, oblong segments $1\frac{1}{4}$ inches ong, with a green tip and sharp centre as if they had een folded, the base of the joined petals only $\frac{1}{4}$ inch ide. The inner 3 segments are petaloide, the lower alf narrow and folded, the upper half broadly spathulate, imsy, green with brown markings, 6 stamens 1 inch ong, filaments inside the folded portion of the inner egments; the anthers club-shaped $\frac{3}{8}$ inch long, dark rown.

The capsule triangular, $\frac{3}{4}$ inch long, $\frac{1}{2}$ inch wide, top attish, a ridge all round, dehiscing in 3 valves, the eeds attached to the centre of each valve.

On first seeing this plant one is reminded of the lovely Brazilian Lily—*Lapageria rosea*, growing in the green-houses in England. The inflorescence of this *Bomarea* is a miniature *Lapageni.*

Parkia biglandulosa, a handsome tall growing tree with a splendidly formed head of strong branches, forming a good shade tree for our streets. The foliage is very fine, fern-like, bipinnate, 15 inches long, pinnae in 20 pairs, pinnules in 44—54 pairs, $\frac{1}{4}$ inch long, $\frac{1}{16}$ inch wide, dark green. A large double gland at the base of the leaf-stalk and 2 or more small glands at the base of the upper pinnae. Inflorescence terminal, 1-6 flowers. Individual flower-stalks 7-10 inches long, strong pendant, flowers aggregated in balls at the end like drum-sticks, a close fringe of whitish filaments $1\frac{1}{4}$ inches diameter and $\frac{1}{4}$ inch wide, the remainder of the ball $2\frac{1}{2}$ inches long, $1\frac{3}{4}$ inches diameter composed of tiny individual flowers; globose heads $1\frac{3}{4}$ inches deep and across, depressed part 1 inch long and same diameter. From the nucleus of the inflorescence which may be about 1 inch in diameter, after the fall of the essential organs, there spring fruits, 1. 2, 3 or more, 9-10 inches long, $1\frac{1}{2}$ inches wide—(stalk 3 inches)—$\frac{1}{4}$ inch or more thick, dark brown, seeds showing plainly. These are very similar in size and colour to those of the Devil's Ear seeds.

The small wild "Karaila," *Momordica Balsamina* common all through the West Indies. In British Guiana it is of little account, growing, flowering and fruiting in the country along the Railway and other fences in the wet season, and drying up in the dry season. In Trinidad it is seen at its best, forming high screens where objectionable out houses, etc., are to be shut out of sight, making a pleasant object without trouble, wire netting or even single wires placed closely, and it is astonishing how quickly a pleasant screen is formed with its pale green, small palmate foliage, pretty little pale yellow flowers and bright orange-coloured fruits. Like the other momordicas it bears monaecious flowers, both male and female flowers being of the same colour and

size. Foliage palmate, deeply cut, $1\frac{3}{4}$ inches across tapering inwards, a spiral tendril opposite, filiform $1\frac{1}{2}$ inches apart, pale green. Inflorescens solitary, male flowers 1 inch across, peduncle $1\frac{1}{4}$ inches long, filiform; corolla bright yellow of 5 petals. Column of stamens $\frac{1}{4}$ inch high and across, of a darker yellow, calyx pale green, $\frac{1}{2}$ inch across of 5 sepals. Female flowers of similar colour and size. Ovary $\frac{5}{16}$ inch diameter, fluted green, column above ovary $\frac{1}{4}$ inch long. Gynaecium $\frac{1}{4}$ inch high, divided filiform. The perfected fruit 2 inches long $1-1\frac{1}{8}$ inches wide, pointed. Shewing the filiform gynaecium, tuberculus with short teeth in 8 or 9 lines from end to end. Orange coloured. If opened before dehiscense takes place, it is found to be filled with 3 rows of seeds closely packed together, these covered with a thick red, sticky putamen. It dehisces in 3 sections; these throw themselves backwards—literally turning inside out—carrying the red seeds fixed in 2 rows on each section, which fall off early. East Indians use these fruits in their cookery.

Ochroma Lagopus, "Bois Flôt," "Bois Tabal," "Bombast Mahoe," "Corkwood," "Down tree," of the West Indies generally, specimen the soft, short, downy mouse-coloured cotton substance. The capsule before detriscense takes place is 9 inches long, and nearly 2 inches diameter, with 10 longitudinal corrugations forming into 5 valves, turning dark brown. As soon as ripe dehiscense takes place, the valves fall off cleanly, leaving the downy substance, which remains on till the wind blows it to pieces, carrying the small brown seeds with it to the ground. As the valves fall off the downy substance expands to quite double the diameter of the closed capsule, still showing the longitudinal marks of the dropped valves. The stalk which holds the fruit (the peduncle) is quite stout, $\frac{1}{2}$ inch thick and 6-8 inches long. Inflorescence terminal, solitary; flowers 3-4 inches long, erect pale yellowish white. Involucre 3-leaved, deciduous, calyx funnel shaped coriaceous, of a reddish colour. Petals twice

the length of the calyx, linear-oblong, wedge-shaped at the base with the limb somewhat expanded, thin, longitudinally veined, puberulous, undulated. Filaments united to form a simple cylindrical, angular column, anthers 5, cohering, spirally twisted, 5-fid at the apex. Ovary conical, 5-sided, style cylindrical, 5-sided enclosed in the tube of the filaments, stigmata 5, an inch long protruding beyond the anthers spirally twisted. Foliage cordate with sloping shoulders and 3 points, 9-12 inches long, 9-10 inches wide, dark green above, glabrous beneath; 7 main ribs radiating from the petiole with well marked straight veins running from these and finer straight veins connecting them, still finer veins connecting the latter—a beautiful specimen of veining—all of a pale yellowish brown on the under surface. Petiole 9-12 inches long. The silk-cotton of the pod is used for making pillows and other articles which require padding, it is admirably adapted for this purpose as it is so beautifully soft. The wood being so light and tough is largely used in the building of Airplanes, and is splendid substitute for cork for entomological work. Specimens from the woods of Trinidad.

Portlandia grandiflora, from Jamaica. A fairly large growing shrub, much like a Magnolia in appearance, very floriferous, with straightish branches, pyramidal. Foliage oblong, dark green shining, $4\frac{3}{4}$—$5\frac{1}{2}$ inches long, $2\frac{1}{4}$—3 inches wide, pointed, leathery, in pairs. An ochrea surrounds the stem, at each pair of leaves. Inflorescens solitary,—though in quantity,—flowers tubular, 6 inches long, base 5 square, $\frac{1}{4}$ inch wide with green corners, enlarging in the tube to $1\frac{1}{4}$ inches wide with deep pink corners. The mouth campanulate with 5 broad and pointed segments $2\frac{1}{4}$ inches across; general colour whitish tinged with pink, the corners, which are a continuation from the segments to the base of a deep pink colour meeting the green corners more than half way down,—5 filiform stames reaching to the base of the segments, lower $\frac{2}{3}$ white, upper $\frac{1}{3}$ yellow. Pistil

rather shorter than the stamens, filiform with a green stigma. A deep chocolate coloured calyx, stem 1 inch long, 5 oblong, pointed segments ⅝ inch long. The fruit, small guava-like with 5 corners the calyx segments superimposed.

THE MOSQUITOES OF BRITISH GUIANA.

By G. E. Bodkin, B.A., Dipl. Agric. (Cantab), F.E.S., Assistant Director and Government Economic Biologist, Department of Science and Agriculture, British Guiana.

Previous local publications on the Mosquitoes of British Guiana consist in the work of Drs. Rowland and Low commencing in 1889 and, later, that performed by the Rev. Aiken and Dr. Rowland. The results of these investigations are contained in the British Guiana Medical Annual for the years 1905, 1906, 1908, 1913 and also in "Timehri," the Journal of the Royal Agricultural and Commercial Society of British Guiana, in July, 1911.

A list of the British Guiana Mosquitoes was published in the Journal of the Board of Agriculture Vol. VIII July, 1915, by F. W. Urich, Entomologist to the Board of Agriculture, Trinidad.

The present condensed list is practically a revision of all previously published lists of British Guiana mosquitoes and it has been drawn up with the aid of Howard, Dyar and Knab's exhaustive monograph on the Mosquitoes of North and Central America and the West Indies.

The nomenclature and classification utilized in this paper is based entirely on this monograph, by its aid it has been possible to make corrections in the locally published,

earlier lists; these corrections materially reduce the number of recorded species. The object of this contribution is to record, in the light of recent researches into the identifications and classifications of this family of Insects, as accurate a list as possible of the present, known species of Mosquitoes in British Guiana, and also to provide, for future investigators, an up to date basis upon which to work.

In preparing this list I am partly indebted to the work of my late Assistant Mr. L. D. Cleare, Jnr., to whom, prior to his leaving this Division, I had delegated the preparation of this paper. Mr. H. W. B. Moore has supplied some valuable notes and information.

SUB-FAMILY CULICINAE.

TRIBE SABETHINI.

Genus Sabethes. Robineau- Desvoidy.

1. *Sabethes tarsopus.* Dyar and Knab.

Two specimens exist in the collection of the Biological Division of the Department of Science and Agriculture. (British Museum identification.) Collected by C. B. Williams, Issororo, North Western District, June 1916. The species is diurnal and will bite man. The locality from which these specimens came is well within the forest area at an elevation of about 150 feet. (Howard, Dyar, and Knab. Vol. 3. Part. i. p. 25.)

2. *Sabethes cyaneus.* (Fabricius) Knab.

Recorded from British Guiana by Theobald who states. "Dr. Low took his specimens in virgin forest during the day." Specimens of this insect are in the British Guiana Museum with a locality " Hyde Park, Demerara River." (H. D. K. Vol. 3. Part i. p. 26.)

3. *Sabethes schausi.* Dyar and Knab.

A single female has been collected at Omai, Essequebo River, by Mr. William Schaus. This is the only record from British Guiana.

4. *Sabethes chiopus.* Dyar and Knab.

A single male has been collected in the Potaro Highlands by M. A. De Freitas in May, 1909. This is the only record from British Guiana.

(Dyar and Knab. Insecutar Insectae Men. I. 6th June, 1912.)

Genus Sabethinus. Lutz.

5. *Sabethinus undosus.* Coquillet.

Howard, Dyar and Knab record this species from British Guiana as follows:—Georgetown, British Guiana, Adult captured August 1st (Dr. E. D. Rowland.) Aiken (B. G. Medical Annual 1908 p. 18) says:—Specimens of these mosquitoes were obtained by Dr. K. S. Wise from the Kanuku Mountains. (H.D.K. Vol. 3. Part i p. 33.)

Genus Sabethoides. Theobald.

6. *Sabethoides nitidus.* Theobald.

Specimens of this insect are in the British Guiana Museum with the localities Dora, Demerara River, July 1908, (M. A. DeFreitas) and Potaro, May, 1909 (M. A. De Freitas). It has also been taken in British Guiana by Dr. Low. (H. D.K. Vol. 3. Part i. p. 37)

Genus Limatus. Theobald.

7. *Limatus durhami.* Theobald.

The following localities have been given for this species :—Potaro, British Guiana, May, 1909 (H. W. B Moore) recorded in H. D. and K.

Rupununi, Collected by K. S. Wise. Recorded by Urich in Journal of the Board of Agriculture, British Guiana. Vol. VIII July, 1915. No. 3.

Georgetown, Essequebo Coast, East Bank, Demerara river (H. W. B. Moore).

The species has been bred by H. W. B. Moore from larvæ collected in the sheathes of the Awarra Palm (*Astrocaryum tucumoides*) (H. D. K. Vol. 3. Part i. p. 42.)

Genus Wyeomyia. Theobald.

8. *Wyeomyia melanocephala.* Dyar and Knab.

This species has been collected in the Rupununi by K. S. Wise (Urich, Journal of the Board of Agriculture of Britsh Guiana. Vol. VIII. July 1915. No. 3.) (H. D. K. Vol. 3. Part i. p. 86)

9. *Wyeomyia pseudopecten.* Dyar and Knab.

A specimen of this insect is in the collection of the Biological Division, Department of Science and Agriculture. (British Museum identification). It was bred from the water contained in Heliconia plants. A commonly occurng species in this district. Issororo, North Western District. G. E. Bodkin, June, 1915. (H. D. K. Vol. 3 Part i. p. 119.)

10. *Wyeomyia bromeliarum* Dand K.

Recorded by Theobald from British Guiana, 1903 also collected by Bodkin and Cleare in the Shelter Belt, Botanic gardens 5. 5. 15. One specimen in the collection of the Biological Division (British Museum identification) (H. D. K. Vol. 3. Part i. p 131).

11. *Wyeomyia chrysomus.* Dand K.

The following localities have been given for this species:—Morawhanna, North Western District, and Demerara River. (Dr. Low in Theobald)

New Amsterdam (Dr. Rowland in Theobald)

Hollandia, Upper Berbice River (Aiken). Aiken has taken the larvæ in the scoop-like bract of a flower of Ravenala sp. (H. D. K. Vol. 3, Part i. p. 70)

12. *Wyeomyia luteoventralis.* Theobald.

Theobald records this species from British Guiana and remarks: The specimens taken by Dr. Low were caught in the forest near the Demerara River at 12 noon in subdued light.

13. *Wyeomyia aporonoma* Dyar and Knab.

Recorded by Urich as having been taken by H. W. B. Moore in Georgetown. (Journal, Board of Agriculture, British Guiana Vol. VIII No. 3. July 1915) (H. D. K. Vol. 3. p. 73)

14. *Wyeomyia chreseta.* Dyar and Knab.

Collected by H. W. B. Moore at Craig, East Bank, Demerara River, Essequebo, West Coast, Demerara. (H. D. K. Vol. 3. Part i. p. 139).

Tribe Culcicini.

Genus Culex Linnæus.

15. *Culex similis.* Theobald.

Two specimens exist in the collection of the Biological Division. Collected at Pln. Blairmont, Berbice. G. E. Bodkin, November, 1920, British Museum identification) (H. D. K. Vol. 3. Part i. p. 342)

16. *Culex quinquefasciatus.* Say.

This well known species is prevalent throughout the coast lands of British Guiana.

Breeds freely in cesspits in Georgetown and other localities. (H. D. K. Vol. 3. Part i. p. 357)

17. *Culex conspirator.* D and K.

A single specimen of this insect is in the collection of the Biological Division with the following data: Bred from larvæ collected in the Botanic Gardens, Georgetown. G. E. Bodkin. L. D. Cleare Jnr. 1. 5. 15 (British Museum identification) (H. D. K. Vol. 3 part i. p. 410)

18. *Culex lateropunctata* Theobald

Recorded from British Guiana by Theobald. (Mono. Culicid iv. 1907. p. 458)

19. *Culex corniger* Theo.

Recorded by Dr. Rowland from Stanleytown, New Amsterdam, British Guiana. Described by Theobald as

Trichopronomyia microannulata. Theobald. (Theobald. Mon. Culicid. iv. 481. 1907.) (H. D. K. Vol. 3. Part i. p. 240).

20, *Culex luteoplurus,* Theobald,

Recorded by Aiken and Rowland (British Guiana Annual, 1905, 1906, 1908, 1911).

21. *Culex indecorabilis,* Theobald.

Recorded by Aiken and Rowland. (British Guiana Annual, 1908, 1911.)

Genus Mansonia. Blanchard.

22. *Mansonia fasciolatus.* Dand K.

Recorded from Schepmoed and Stanleytown, British Guiana. (Rowland) Rupununi. (K. S. Wise) Botanic Gardens, Skeldon, Anna Regina, Craig, Nonpareil, Ida Sabina. (H. W. B. Moore) (H. D. K. Vol 3. Part i. p. 513).

23. *Mansonia titillans* (Walker) Blanchard.

Recorded from Berbice (Aiken) Georgetown. (H. W. B. Moore) (H. D. K. Vol. 3. Part i. p. 517)

Genus Psorophora. Robineau Desvoidy.

24. *Psorophora cilipes.* (Fabricius). Dyar and Knab.

Two specimens are in the collection of the Biological Division. (British Museum identification) Both from Onderneeming, Essequebo (G. E. Bodkin). The species has also been recorded as follows:—Sipuruni Creek, Essequebo River (K. S. Wise) Potaro (De Freitas) Ida Sabina, Berbice (Moore) (H. D. K. Vol. 3. Part 2. p. 538.)

Trichopronomyia microannulata. Theobald. (Theobald. Mon. Culicid. iv. 481. 1907.) (H. D. K. Vol. 3. Part i. p. 240).

20, *Culex luteoplurus,* Theobald,

Recorded by Aiken and Rowland (British Guiana Annual, 1905, 1906, 1908, 1911).

21. *Culex indecorabilis,* Theobald.

Recorded by Aiken and Rowland. (British Guiana Annual, 1908, 1911.)

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Sub-genus Janthinosoma. Arribalzaga. Lynch,

25. *Psorophora posticatus.* Wild.

Two specimens are in the collection of the Biological Division (B. Museum identification) with the following note Bred from larvæ collected in stagnant water containing 'many dead leaves. Larvæ swarming. Shelter Belt,

Botanic Gardens. 7. 5. 15. G. E. Bodkin. It has also been recorded from Berbice (Aiken) and Georgetown (Rowland). (H. D. K. Vol. 3. Part 2. p. 348)

26. *Psorophora lutzii.* Theo.

This species is recorded by Howard, Dyar and Knab from British Guiana as follows :—Rupununi (K. S. Wise). It is also recorded by H. W. B. Moore from Lodge Village (Near Georgetown) 28. 10. 09 and Potaro. May, 1910. De Freitas. (H. D. K. Vol. 3, Part 2. p. 557)

27. *Psorophora cingulatus.* Fabricius.

Recorded from British Guiana by Theobald. (H. D. K. Vol. 3. Part 2. p. 597)

Genus Aedes. Meigen

28. *Aedes fulvus* (Weidemann) Knab.

Recorded from British Guiana by Aiken(H. D. K. Vol. 3. Part 2. p. 624)

29. *Aedes taeniorhynchus* (Wiedemann) Busck.

Several specimens of this insect are in the collection of the Biological Division (British Museum Identification). It is a very common species and has been recorded from most parts of the coastlands of British Guiana (H. D. K. Vol. 3 Part 2. p. 667)

30. *Aedes nubilus.* (Theobald.) Howard, Dyar and Knab, record this species from British Guiana as follows: Rupununi. (K. S. Wise) (H. D.K. Vol. 3. Part 2. p. 783).

31. *Aedes scapularis* (Rondani) Pazos.

Recorded from British Guiana by Rowland and Aiken. Several specimens are in the collection of the Biological Division. (British Museum identification) from Berbice and Botanic Gardens, Georgetown. (G. E. Bodkin and L. D. Cleare, Jnr.) (H. D. K. Vol. 3 Part 2. p. 783)

32. *Aedes pertinax.* Grabham.

Recorded from Botanic Gardens, Georgetown, May 1915. (Bodkin and Cleare) (H.D.K. Vol. 3. Part 2. p. 791).

33. *Aedes serratus.* (Theobald) Dyar and Knab.

Recorded from British Guiana by Rowland and Aiken (H.D.K. Vol. 3. Part 2. p. 794).

34 *Aedes argenteus.* Poiret.

Specimens of this mosquito are in the collection of the Biological Division (British Museum identification). It has been recorded all along the coastlands of British Guiana, (H.D.K. Vol. 3. Part 2. p. 827).

Genus Haemagogus. Williston.

35. *Haemagogus splendens.* Williston.

Recorded from British Guiana by Theobald. (H.D.K. Vol. 3. Part 2. p. 865).

36. *Haemagogus albomaculatus.* Theobald.

One specimen of this mosquito is in the collection of the Biological Division. (British Museum identification). Locality—Issororo, North Western district. G. E. Bodkin, June 1915. Recorded also from British Guiana by Theobald. (H.D.K. Vol. 3. Part 2. p. 868).

37. *Haemagogus equinus.* Theobald.

Recorded from British Guiana by Rowland 21. 1. 06. (H.D.K. Vol. 3. Part 2. p. 871).

38. *Haemagogus capricornii.* Lutz.

Recorded from Tumatumari, Potaro, British Guiana by Bodkin. December 1916. (British Museum identification) (H D.K. Vol 3. Part 2. p. 867).

Genus Orthopodomyia. Theobald.

39. *Orthopodomyia fuscipes.* Coquillet.

Recorded by Howard, Dyar and Knab from British Guiana as follows:—Omai, British Guiana (K. S. Wise) (H.D.K. Vol. 3. Part 2. p. 882).

Genus Aedeomyia. Theobald.

40. *Aedeomyia squamipennis.* (Lynch Arribalzaga.) Theobald. Recorded from British Guiana by Aiken and Moore. Several specimens are in the collection of

the Biological Division (British Museum identification.) Recorded from Botanic Gardens, Georgetown. (Bodkin and Cleare) and from Berbice, British Guiana. (Bodkin) (H.D.K. Vol. 3. Part 2, p. 894).

Genus Uranotaenia. Lynch Arribalzaga.

41. *Uranotaenia pulcherrma.* Lynch Arribalzaga.

Recorded by Howard, Dyar and Knab from British Guiana as follows:—Georgetown, (H. W. B. Moore) (H.D.K. Vol. 3. Part 2. p. 908).

42. *Uranotaenia lowii.* Theobald.

Recorded from British Guiana by Aiken and Rowland (Berbice and Georgetown) (H.D.K. Vol. 3. Part 2. p. 911).

43. *Uranotaenia geometrica.* Theobald.

Several specimens are in the collection of the Biological Division (British Museum identifications). One specimen has attached note " Pupae in artesian well water trench (Rice irrigation, surface thereof covered with scum and Salvinia) D'Urban Park, Georgetown. L. D. Cleare jnr. 30. 4. 18. Recorded also from British Guiana by Moore and Bodkin (Georgetown and Berbice). Also by Rowland. (H.D.K. Vol. 3. Part 2. p. 918).

44. *Uranotaenia rowlandii.* Theobald.

Recorded from New Amsterdam, British Guiana by Theobald (Mono Culicid in p. 566. 1907.)

45. *Uranotaenia leucoptera.* Theobald.

Recorded from British Guiana by Theobald. (Mono Culicid iv.p. 575. 1907.)

GROUP MEGHARINES.

Genus Megharinus (Robineau—Desvoidy.)

46. ***Megharinus superbus.*** Dyar and Knab.

A specimen of this insect is in the collection of the Biological Division (British Museum identification) from Essequebo (Bodkin) Recorded also from British Guiana by H. W. B. Moore and Siparuni Creek, Essequebo River, (Wise) H.D.K. Vol. 3. Part 2. p. 932.

47. *Megharinus separatus.* Arribalzaga.

Recorded from British Guiana by Aiken (B.G. Med. Ann. 1905. pp. 15 & 36.)

48 *Megharinus haemorroidalis.* Fab.

Recorded by Urich (Journal, Board of Agriculture, British Guiana Vol. VIII. No. 3. July 1913) from British Guiana as follows:—Omai. (K. S. Wise) Siparuni Creek (Wise.)

GROUP ANOPHELENES.

Genus Anopheles Meigen.

49. *Anopheles argyritarsis* Robineau—Desvoidy

Several specimens of this mosquito are in collection of the Biological Division (British Museum identifications). They are recorded from Potaro. (Bodkin). They are also recorded by Aiken from New Amsterdam, and Botanic Gardens, Georgetown, L. D. Cleare, Jnr. (H. D. K, Vol.3. Part 2. p. 967).

50. *Anopheles tarsimaculata.* Goeldi.

Specimens of this Anopheline are in the Biological collection from Botanic Gardens, Georgetown, Berbice, East Bank, Demerara. (G. E. Bodkin). They are also recorded from Berbice by Aiken and Rowland. (H. D. K. Vol. 3. Part. 2. p. 967).

51. *Anopheles lutzii.* Theobald.

Recorded from British Guiana by Dr. Low—Coriabo, Barima River, North Western District. (H. D. K. Vol. 3. Part 2. p. 971.)

52. *Anopheles mediopunctatus.* (Theobald.) Dyar and Knab.

Recorded from British Guiana by Theobald. (H. D. K. Vol. 3. Part 2. p. 993).

53. *Anopheles nimba.* Theobald.

Recorded from British Guiana by Theobald (Mono. Culicid p. 62. 1903).

54. *Anopheles nigra*, Theobald.

Recorded from British Guiana by Theobald also Aiken. (British Guiana Medical Annual 1908. pp. 3, 4, & 22.)

How to Make Farm Machinery Last.

1. Learn every adjustment and its purpose.

2. Oil all bearings, gears, shafts, etc., where there is friction.

3. Keep all machinery housed and give each implement a coat of paint at least every two years.

4. Keep all bolts and nuts tight and snug.

5. Grease all landsides, mouldboards, shares, cultivators, shovels, and discs when they are to be out of use more than two or three days.

BOTANICAL, PLANT DISEASES AND PEST NOTES.

REPORT ON MALARIAL MOSQUITOES IN THE POTARO DISTRICT.

BIOLOGICAL DIVISION,
7TH FEBRUARY, 1921.

SIR,

I have the honour to submit herewith my report on the mosquito survey of the Potaro District.

I left Georgetown on21st January, 1921, and returned on 31st January, 1921. I was accompanied by Mr. F. Stell, Assistant Government Botanist and Mycologist; this Officer was of material assistance in performing the somewhat arduous work at times entailed by this survey. Our thanks are due to Brigadier-General Rice for courteously granting us every facility for the successful prosecution of the work. Our movements were hindered on some days by heavy and persistent rain.

2. The following places were most carefully investigated. A large number of human habitations along the Potaro road from the landing up to 16th Mile, the entire headquarters of the Minnehaha Development Company at 10 miles and also 15 miles and the Government Compound containing Court House, Rest House, Hospital, Police Quarters, and Post Office at 11½ miles along with its environments. During the investigation the following points were observed, (1) the particular pieces of water, either stagnant or running, which were breeding mosquitoes: (2) the species of mosquitoes concerned. The usual technique with regard to dipping and breeding larvae was observed.

3. As the headquarters of the Minnehaha Development Company at 10 miles are now the most populous centre of the Potaro it may not be out of place to detail the various enquiries made here. During the first night of our stay in these quarters I was immensely surprised to observe that they were infested with a species of Anopheles mosquito which, on examination, I had no hesitation in

identifying as the common malaria-bearing species *Anopheles argyritarsis R.D.* Its presence was all the more surprising to me as I have only on one previous occasion observed this species of mosquito at any distance from the coastlands: I refer to Rockstone, the terminus of the Wismar-Rockstone railway, where it is of common occurrence and the locality bears a sinister reputation for malarial infection.

A careful inspection was made of the environments of the quarters at 10 miles and I was successful in detecting the breeding-place of these Anopheles mosquitoes.

Not far from the house, and surrounded by vegetation was a great pile of empty tins some of recent origin, others almost ancient. Nearly all contained water which was kept constantly fresh owing to the drippings from the surrounding vegetation: the annual Potaro rainfall consists of some 150 inches. Some of the larger and older tins supported vegetation and in these receptacles particularly the larvae of *Anopheles argyritarsis, R.D.* were to be found.

The soil in this vicinity does not hold water for any length of time and natural accumulations of water as might be occasioned by drains, etc., do not exist owing to the fact that behind the house the ground slopes sharply downwards. At the foot of this incline there is a creek of some size and a number of pits caused by gold workings in days gone by. I examined these pits and the creek but was unable to detect the presence of mosquito larvae. In both the water was discoloured and the margins were grass-grown.

The various dwellings and other erections such as stables, machine-shop, bakery, store, etc., were examined In every instance I was struck by the entire absence of any effort whatsoever either to screen receptacles for collecting rain water or to do away with the mounds of empty tins, flasks and bottles. Many of the rain water barrels and tubs were literally alive with mosquito larvae which consisted almost solely of *Aedes argenteus,* Poiret. and *Culex quinquefasciatus.* Say. While the larvae of the previously mentioned species of Anopheles was not uncom-

mon. Similar conditions prevailed at every dwelling-house which was inspected throughout the Potaro. During the two nights which were spent at the quarters of the Minnehaha Development Company at 15 miles I was unable to detect the presence of Anopheles mosquitoes; this, despite the fact that a careful watch was maintained till late at night. Our inspections of the streams in the neighbourhood were also unsuccessful. Many of the dwellings along the Potaro road, about a mile from our quarters, were breeding mosquitoes however.

I was particularly interested in the large Government Compound at 11½ miles which, I understand, has a particularly unenviable reputation for malaria.

We closely inspected the whole compound and only a few empty tins were detected. Receptacles for rain water were in a satisfactory condition. In fact, the whole compound can be said to be practically free from mosquito-breeding conditions, yet malignant malaria was prevalent and several people testified to the presence at night of the species of mosquito locally known as "galli-nippers" which I well know to be none other than Anopheles.

About 100 yards from one side of the compound a small greatly grass-grown stream of clear water flows under a bridge across the road and it is from this source that the supply of *Anopheles argyritarsis, R.D.* is derived. A few dips of the ladle demonstrated their presence in considerable numbers. It is thus possible for a patient to be admitted to this Hospital and therein contract malarial fever.

4. *General Remarks and Conclusions*: (1) The malarial carrying mosquito *Anopheles argyritarsis, R.D.* is prevalent in the Potaro District in the vicinity of the Potaro road.

(2) It breeds in old tins and other receptacles lying in heaps beneath vegetation where, owing to the rainfall, a constant supply of fresh water is available. In one instance it was observed to breed in a clear water stream much overgrown with grass. In fact the Potaro is a district of empty tins, flasks, bottles, tubs and barrels. It must be borne in mind that the food and drink supply of the district

has, owing to its distance from civilized centres, to be conveyed in such receptacles.

(3) Potaro fever is well known but the cause, as far as I know, has hitherto remained shrouded in mystery. The detection of the malarial carrying mosquito and the fact that it is present in considerable numbers explains the origin of this fever; the climatic conditions of the Potaro may possibly aggravate the malaria when once contracted; its source, however, is sure.

5. The following species of mosquitoes were taken during our stay in the district. There are some others which I am unable to identify personally and which will have to be forwarded to the Imperial Bureau of Entomology—

Anopheles argyritarsis, *R.D.*
Aedes argenteus, Poiret.
Culex quinquefasciatus. Say.
Sabethoides nitidus. Theo.
Limatus durhami. Theo.
Uranotaenia geometrica. Theo.

I have the honour to be,
Sir,
Your obedient Servant,
G. E. BODKIN,
Government Economic Biologist.

THE DIRECTOR OF SCIENCE AND AGRICULTURE.

A SIMPLE POLLINATING APPARATUS.

In the *Agricultural Journal of India*, Vol. XVI, Part II, T. S. Venkatraman describes a simple apparatus devised by him for pollinating sugar-cane arrows at the sugar-cane breeding station, Coimbatore.

Pollen to be used is collected in tiny gelatin capsules such as are used by druggists for the administration of unpalatable medicines. The arrow of sugar-cane to be cross-pollinated is then selected, and the pollen-charged

capsule is inserted at the tube end of a 'blowing-'ball such as is used on perfumery bottles. By means of a darning needle, a puncture is then made at the posterior end of the capsule, and through this small hole the pollen can be conveniently and naturally sprayed in the neighbourhood of the recipient stigmas.

It is stated that both the pollen collecting and the spraying should only be done during reasonably dry weather.

It is also important that sugar-cane pollen can be repeatedly tested for viability. Sugar-cane poven germinates freely on the stigmas of *Datura fatuosa*, far *alba*, Mr. Venkatraman states.

The apparatus can be used for all kinds of pollen, and it should certainly facilitate manipulation in this often tedious and trying operation.

THE ORIGIN OF THE COCO-NUT PALM.

Studies in the origin of cultivated plants are exceedingly interesting, historically as well as botanically. In fact, it can be affirmed that such studies are in the broad sense, essentially historical, embracing as they do, ethnology, or the origin of human races, agricultural history and the historical side of botany. And the results of such studies can be useful as well as interesting. They furnish us with information as to what are the proper ecological conditions or 'surroundings' demanded by domesticated species under natural conditions, and they give an insight into methods of plant dispersal, and into the physiological or functional significance of certain specific characters. From the standpoint of tradition, it is inspiring to the present inhabitants of a region to find that their territory is the native home of a useful plant, and still more inspiring the fact that the former inhabitants—perhaps or perhaps not their ancestors—were responsible for bringing that useful plant under domestication, and disseminating

it to other places where it proved of great benefit to mankind.

The approximate region of origin of many cultivated tropical plants, of both major and minor importance, are definitely known. For example, Indian corn (or maize) and cacao undoubtedly originated in Central America; the sugar-cane in the east of India or Cochin China; the banana in Southern Asia.* But we do not possess indisputable evidence in connection with every cultivated plant and a striking example is to be found in the case of the coconut.

Attaching to the coconut is much romance: its obscure origin; its indispensability to the Polynesians from pre-historic times up to the present day; its relative unimportance to the people of tropical America; and lastly, its phenomenal increase in importance during the last twenty years in manufacturing industries of northern countries. And there are several very popular and fixed ideas concerning the coconut: it is generally pictured 'at home' fringing the shores of tropical islands, and the idea is also general that the fruit is specially adapted for dispersal by ocean currents. These considerations arouse a natural desire to know exactly how the coconut originated, and what are and have been its relationships to mankind in respect of dispersal. It has certainly played, and continues to play, a very important part in human history and economics.

So far as we are aware, the two most recent and competent contributions to the origin of the coconut are by O. F. Cook,† and O. Beccari.‡ Cook's memoir is by far the most exhaustive study of the subject, and maintains an American origin of the species; Beccari's paper is mainly a *critique* on Cook's paper, but it raises questions of importance which are not fully dealt with by Cook: Beccari holds the view that the coconut is of Asiatic origin. In addition to the views of these two botanists, we also

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*De. Candolle: 'Origin of Cultivated Plants,' 1909.

†The Coconut Palm in America': O. F. Cook: *Contributions from the United States National Herbarium*, Vol. 14 pp. 271-342 (1910).

‡' The origin and Dispersal of *Cocos nucifera*': O. Beccari. *The Philippine Journal of Science*, C. Botany, Vol. XII, No 1. Jan. 1917

have Copeland in the Philippines adhering to the American origin, and Wester, also in the Philippines, holding Beccari's view of an Asiatic origin Apparently the views of Copeland and Wester are not based on any original enquiry of their own.

Cook's arguments are briefly as follows: He points out that all other members of the family Cocoineae, except the African oil palm (*Elaeis guineensis*), are American. From this he argues, that the member under consideration—the coconut (*Cocos nucifera*)—is also likely to be American. Next, by research into early literature, he brings evidence to show that the coconut existed in tropical America (including Columbia) prior to the arrival of the Portuguese and Spaniards, and by this evidence shows that the species was not introduced by the early European settlers. He adduces evidence to show that some of the Central American aboriginal tribes have the name 'ko-ko,' which applies to the coconut, as well as other names. Cook considers that the name 'coco' is of American origin and was not introduced from the East. He then endeavours to prove that the coconut is not able to maintain itself, without the aid of man, or seacoasts, as is evidenced by conditions in the Cocos Islands. He states that the fruit of the coconut is adapted for germinating under semi-desert conditions, and that the circumstance that the fruit floats is merely incidental. The coconut, he says, thrives well in interior localities (alkaline soils) at the present day (*e.g.*, interior of Columbia and Guatemala). A further point Cook makes is that several special Cocoineae have been domesticated in Central America. This indicates the interest taken, and the importance which the aboriginal American Indians attached to the palms.

Cook next brings evidence to show that the Polynesians visited the Pacific coast of Panama and Columbia in pre-historic days.*

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*The distance across the Pacific from Panama to the nearest Polynesian (or South Sea) Islands is the same as the distance across the Atlantic from Lisbon (Portugal) to the Leeward Islands (West Indies)—about 2,500 miles. Hence the voyages of the Polynesians were as long as those of Columbus, and accomplished, at a much earlier date in much smaller ships.

In regard to the suggested introduction of the coconut into Polynesia from Southern Asia, Cook holds that this did not occur, otherwise toddy manufacture, well known in Asia from pre-historic times, but not known in Polynesia, would have been introduced also.

The greater number of varieties of coconut in the East than in America, is stated to be no argument against American origin, indicating in fact the more recent presence of the 'unimproved' wild stock in America.

Finally, Cook attributes the absence of the coconut palm in Peru to unfavourable climatic conditions (overcast skies).

His general conclusion is that the coco-nut originated in the salt-spring deserts of Columbia, where it was seen growing wild by Cieza de Leon during the middle of the sixteenth century (about 1540).

Beccari, in his paper, refutes most of these arguments. He says that recent botanical discoveries have lessened the likelihood of the Cocoineae being entirely of American origin, and cites the discovery of another true Cocoineae in South Africa (*Jubaeopsis caffra*, Beccari). He thinks *Cocos nucifera* probably assumed its present specific characters in some lands or islands existing in former times between Africa and India

The second point which Beccari makes, is the association of the 'robber crab' with the coconut palm. This crab (*Birgus latro*) is specially adapted for climbing the trees, and for grasping and breaking the nuts. Beccari thinks that this adaptation could not have been evolved independently of the coconut and presumably he assumes that the association must have started before the period of primæval man. The robber crab does not occur in the Pacific coast of tropical America.

Beccari further maintains that Cook's evidence of the distribution of the coconut on the Atlantic side of Central America before the arrival of Europeans is unconvincing.

Beccari next brings evidence to show that the coconut fruit is capable of being dispersed by ocean currents. As an example, he refers to the natural re-stocking of the

islands in Sunda Strait, after the eruption of Krakatau Coconuts appeared without human agency.

He also brings evidence to show that the coconut palm does not always stand in need of the assistance of man for its existence and reproduction on the seashore. Observations in the Palmyra Islands are referred to in this connexion.

Lastly, Beccari maintains that the coconut palm is as tree halophyte particularly adapted to tropical seacoasts, and to oceanic dispersal.

In regard to Beccari's first point, the discovery of another member of the Cocoineae in Africa, does not alter the fact that the large majority of the members of this family are indigenous to America.

His second point, with reference to *Birgus latro* is not referred to by Cook, but Smith* states that this crab may have evolved its peculiar characteristics on palms other than the coconut.

With regard to Cook's evidence of the coconut being of very widespread distribution on the arrival of Columbus and later discoverers in America, there would appear to be some grounds for Beccari's objection. The difficulty is to be certain that these early writers knew exactly what species of palm they were referring to. As Cook points out, the coconut was not likely to have been present in large numbers, because the Indians, in pre-Columbian days, lived principally on Indian Corn: the coconut had no economic status.

There would appear to be no doubt that the coconut is capable of being disseminated by ocean currents; though whether this has ever had much influence on the dispersal of the palm, is another matter.

The question as to whether coconut trees can perpetuate themselves on the seashore indefinitely, without the aid of man, is a doubtful one. But it is a matter that could easily be decided by observation.

Beccari maintains that the coconut is a true halophyte. Presumably he means a true marine halophyte. Copeland

* Cambridge Natural History : Crustaceans.

states that the coconut is not a true halophyte: it merely tolerates salt.

There is one point which both Cook and Beccari appear to overlook, and that is the adaptation of the coconut to withstand wind. This is seen in the strength and divided nature of the leaves, the yielding trunk, the extensive root system, and the strength of the female flowers both as regards their structure and their attachment. From an agricultural standpoint, it is well-known that the coconut palm requires thorough ventilation of the leaves, as well as of the soil in which it grows. It would be interesting to know what the climatic conditions in regard to wind are, and what are the exact soil conditions in the Columbian region, which Cook considers the coconut's home.

Taking a general view of all the arguments put forward, it would seem that the question of the origin of the coconut requires further investigation, especially in regard to the botanical, archeological, and geological study of the regions held to be its home. One of two things seems likely, either that the Polynesians took the coconut to the Pacific coast of Central America, or else brought it from that coast to their own islands.

Assuming that the coconut was taken from America to Polynesia, it must have been growing fairly abundantly on the American coast, for it is not likely that the primitive Polynesians would have penetrated the Andes in search of a palm likely to be suited to the saline and exposed conditions of their tropical islands. If the coconut did not evolve under littoral conditions, how was it carried to these conditions—who brought it from Cook's 'interior valleys and plateaus of the Andes' to the seashore which turned out to be so miraculously suited to its requirements ?—Agricultural News, Vol. xx. No. 501. July, 1921.

COCKROACH CONTROL.—1. Traps may be used as a means of control, but cannot be relied on as a method of extermination. Sugar liquor slightly poisoned used to be a favourite trap. Poisons however are always dangerous.

2. Boric acid is a safe and economical material to use against the cockroaches, as it is non-poisonous to human beings, and yet very effective against cockroaches.

3. A mixture of equal parts of powdered borax and powdered sugar ground together is effective against cockroaches, is safe and economical, although acting slower than boric acid.

4. Cockroaches eat these substances in an effort to keep clean, and not for any possible food value.

The large cockroach which is more frequently a household pest in the West Indies may be controlled by the same means—the use of boric acid. This is freely scattered in places frequented by the cockroaches, and as they move about in search of food the boric acid adheres to their legs, bodies and antennae and in cleaning it off with their mouth-parts, they eat enough to cause their death.

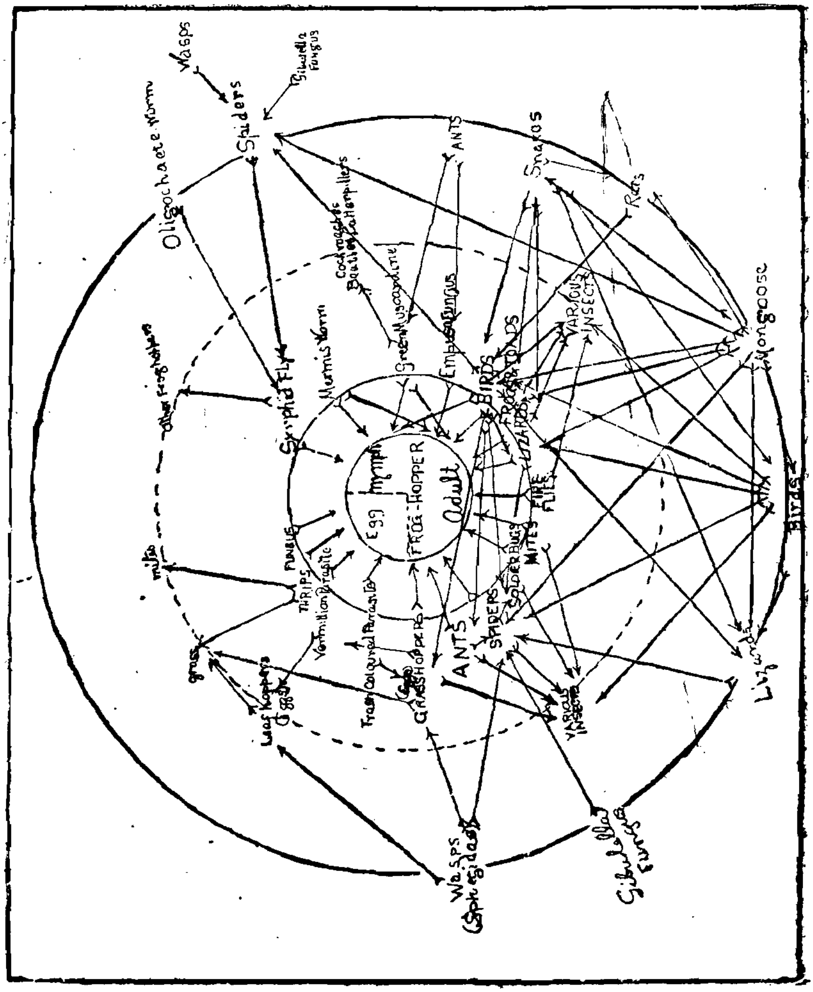
A cockroach covered with dust or dirt will, when unmolested, again begin a process of cleaning. Usually it *draws first one antenna after the other slowly between* the mandibles, then begins on the legs, later the abdomen, doubling up almost into a ball until it cleans itself thoroughly. Boric acid, being a very fine, light powder, readily adheres to the insect's legs and body, and must be cleaned off. The powdered borax and sugar mixture is heavier, and readily hardens if moisture is present, so is not so well distributed upon the parts of the insect's body. Hence the greater efficiency of boric acid as compared with the borax and sugar mixture.—*Journal of the Jamaica Agricultural Society.*

THE PARASITE COMPLEX.

In the memoirs of the Department of Agriculture, Trinidad and Tobago, a Report has recently been published on the Froghopper-Blight of Sugar Cane in Trinidad by C. B. Williams, M.A, F.E.S, *entomologist in charge of Froghopper investigations. It is a most exhaustive report and constitutes a history of the famous Trinidad Froghopper and of all the work that Mr. Williams himself has carried out and that of his predecessors in the same field.*

The diagram from this report which we reproduce beneath, accompanied by Mr. Williams' explanation thereof, is of very particular interest and, as he remarks, should go far in disillusioning those who are constantly advocating the introduction of parasites as an almost certain method of dealing with insect pests. The relationships which the diagram illustrates are almost human in their complexity!

EDITOR.



In the above an attempt has been made to show in diagramatic form the way in which the various parasites, hyper-parasites, and fungi connected with the froghopper are inter-related. In the centre the froghopper is shown and in the first ring round it are all its natural enemies grouped according as they feed on the egg, nymph or adult. In the outermost ring are the hyper-parasites, or enemies of the enemies, and in the intermediate ring are shown other hosts or foods of the parasites and hyper-parasites. The arrows indicate that the animal at the feathers of the arrow destroys the animal at the tip.

A careful study of this diagram will show the extraordinary complexity of the relationships and the great difficulty of deciding whether any particular animal is valuable or undesirable. Thus it will be seen that birds eat froghoppers, but they also eat lizards, which in turn eat froghoppers. The mongoose eats birds, which eat froghoppers, and as such it is undesirable. But the mongoose also eats rats, which eat birds, which eat lizards, which eat spiders, which eat syrphid flies, which eat froghoppers. What conclusion can be drawn from this?

It is hoped that an examination of this diagram will disillusion those who speak of the "Introduction of New Enemies" as if it were a remedy the obviousness of which was only exceeded by its simplicity and certainty of success.

MEETING OF THE NEW BOARD OF AGRICULTURE.

A meeting of the Board of Agriculture under the new Ordinance of 1920 was held at the offices of the Board, Broad Street, on Friday, August 5th, 1921. His Excellency the Officer Administering the Government, Hon. C. Clementi, C.M.G. (President), presided. Also present were

Sir John Harrison, C.M.G (Chairman), G. E. Bodkin (Deputy Chairman), C. Shankland, H. L. Humphrys, B. Gainfort, J. Crabtree, S. H. Bayley, E. Beckett, A. Seton Milne, T. Earle, R. Ward, Rev. E. R. O. Robertson and E.M. Peterkin (Secretary to the Board)

By-Laws And Regulations.

The Chairman laid on the table the Board of Agriculture Ordinance 1920, and reported the appointment of members of the Board. The Registration of Mr D. H. Rylands as a Veterinary Surgeon was also notified.

By-laws Relating to the Botanic Gardens and D'Urban Park, traffic in the Botanic Gardens, Public Gardens, New Amsterdam, subsidiary stations of the Board and the Promenade, and Company Path Gardens were considered and adopted.

Regulations of the Board were adopted with respect to the affiliation of District Agricultural and Farming Associations. The Secretary, The Library. The Editor of the Journal. The Executive Committee. The Exhibitions Committee. The Subsidiary Products Committee. The live Stock Committee. The Veterinary Committee. The Contagious Diseases (Animals) Committee. The Plant Diseases and Pests Committee. The Destructive Pests Committee, The Government Farms Committee. The Ornamental Gardens Committee. The Stallions Control Committee. Rules governing Services. The D'Urban Park—agistment of horses and sheep and cutting of grass. Plant diseases and pests prevention—sugar canes. Plant diseases and pests—Para Rubber. Improvement of breed and prevention of contagious diseases (animals)—notification of illness. Plant diseases and pests (prevention)—inspectors.

Improvement of breed and prevention of contagious diseases (animals)—regulating movement of animals out of infected area. Improvement of breed and prevention of contagious diseases (animals)—persons to inoculate and bleed animals. Order prohibiting importation of dogs.

Agricultural Census, 1920.

The Chairman in laying on the table a statement of the results of the agricultural census for 1919 and 1920 remarked that there was a falling off in all agricultural products in 1920. He deprecated the growing habit among rice cultivators of planting too late. Owing to this habit there were 9,000 acres less under rice cultivation in the colony than the year before. The rice growers not only missed the season but ran the risk of failure to reap during the rainy season in December.

A considerable discussion then took place relative to the correct period at which to plant rice. The consensus of opinion appeared to be that where an assured water supply is present, early planting should be enforced but in other districts where the rice farmers had to trust to the weather for the necessary supply of water the farmers often had to wait for a seasonable time to sow.

Results of the Agricultural Census for 1919 and 1920.

The following are the returns laid on the table by the Chairman.

Crops of	*1919.*	*1920.*
	Acres.	Acres.
Sugar Cane ...	70,876	59,532
Rice Total Acreage	61,405	54,433
,, Spring Crop...	12,820	14,023
,, Autumn ,, ...	61,405	51,718
,, Total acreage reaped	74,225	65,741
Coconuts ...	27,518	24,425
Cacao	2,147	1,846
Coffee	5,125	5,051
Rubber	4,042	2,813
Limes	1,325	1,054
Ground Provisions...	18,192	15,686
Maize	no returns	1,147

LIVE STOCK.

Horses, Coastlands	890	941
,, *Hinterlands* (estimated)	300	300
Mules, Coastlands	2,360	2,105
Donkeys	6,985	7,106
Cattle, Coastlands	79,614	85,938
,, Hinterland	26,000	26 000
,, *Total* ...	*105,614*	*111,938*
Buffaloes	193	174
Goats	10,920	11,250
Sheep	20,110	22,202
Swine	15,580	17,401

BRITISH GUIANA

RICE CROPS, 1920.

Bags of 140lbs Padi.

County of Berbice.	*Spring Crop.*	*Autumn Crop*
Corentyne ...	4.5	Nil
Berbice and Canje River District ...	16.0	15.9
West Berbice ...	.9	2.9
County of Demerara.		
Mahaica and Mahaicony District ...	—	15.0
East Coast ...	.9	19.7
Demerara River District ...	8.8	9.7
West Demerara ...	14.0	16.0
County of Essequibo.		
Essequibo River Islands ...	13.5	19.2
Essequibo Mainland	12.3	16.7
Pomeroon ...	—	11.1

Whole Colony.	*Per acre reaped.*
Spring Crop	9.7 bags of 140 lbs Padi.
Autumn ,,	11.2 ,, ,, ,, ,,
Both Crops	10.0 ,, ,, ,, ,,

MORE IMPORTANT CATTLE AND RICE DISTRICTS.

Districts	*Years.*	*Cattle (head.)*	*(Rice acres)*
County of Berbice.	1915	24,991	14,179
	1916	21,942	18,926
	1917	26,717	17,266
West Berbice & Abary District.	1918	25,556	16,881
	1919	23,303	23,361
	1920	24,046	23,444
Berbice and Canje Districts.	1915	11,318	6,506
	1916	12,261	6,055
	1917	14,962	6,581
	1918	12,733	6,920
	1919	13,902	9,852
	1920	17,506	6,597
Berbice Corentyne District.	1915	24,431	8,743
	1916	27,750	9,841
	1917	18,607	10,000
	1918	12,646	11,963
	1919	12,812	9,504
	1920	13,348	2,720
County of Demerara.	1915	11,207	5,374
	1916	9,590	5,491
	1917	9,661	6,143
	1918	10,576	7,127
Mahaica & E. Demerara	1919	11,166	4,573
	1920	10,267	11,394

LESS IMPORTANT CATTLE AND RICE DISTRICTS.

Districts.	*Years.*	*Cattle (head)*	*Rice (acres.)*
	1915	5,562	4,936
County of Berbice	1916	5,895	5,050
	1917	6,722	6,061
	1918	5,269	7,922
	1919	5,419	4,495
West Demerara	1920	7,114	4,530

East Bank Demerara River	1915	1,739	739
	1916	1,536	3,173
	1917	1,536	3,311
	1918	1,736	1,035
	1919	1,615	833
	1920	1,256	896
County of Essequibo.	1915	5,532	6,041
	1916	6,091	4,466
	1917	6,132	4,320
	1918	5,743	5,025
East and West Essequibo.	1919	7,057	4,819
	1920	7,396	4,334
Essequibo River Islands	1915	3,068	3,928
	1916	3,410	4,072
	1917	2,913	4,073
	1918	2,392	3,527
	1919	3,161	3,471
	1920	3,695	3,783

Decrease in Rice and Cattle.

The Chairman remarked that the production of rice per acre had fallen off 60 per cent. last year. The number of cattle and horses had also fallen off. The Veterinary Surgeon in replying to a query on this matter stated that he could give no adequate explanation of the decrease. There had been no recent epidemic but severe droughts had been experienced which had proved in some instances disastrous to animals. Some question was raised as to the accuracy of the returns furnished.

Exportation of Sheep, Goats and Swine.

His Excellency asked for an expression of opinion from the Board concerning the exportation of sheep, goats and swine. The Chairman remarked that in 1915 an outbreak of swine fever in the Buxton area had caused a loss of 30 per cent. of the normal number of pigs in the Colony and their exportation to Dutch Guiana had consequently to be stopped.

The Board eventually agreed that the exportation of these animals might be allowed.

Agricultural Shows.

A number of petitions for grants of money, to various Agricultural Societies, to hold Agricultural Shows were refused by the Board on the grounds of economy and their apparent uselessness as a means of helping the farmers. A sum of $1,500 was allocated to the Live Stock Committee for the purchase of Live Stock; a number of applications from Agricultural Societies for affiliation were considered and a number of Quarantine Orders were revoked.

Dumb Rabies.

The Government Veterinary Surgeon gave a statement concerning the difference between dumb Rabies and sunstroke.

His Excellency in terminating the proceedings said that the Board should record its gratification that the Chairman had been Knighted by His Majesty the King.

GENERAL PRACTICES IN YAM GROWING.

The kinds of yams commonly grown in Porto Rico are not particularly sensitive to the type of soil in which they grow, provided the weather conditions are favourable and the proper cultural practice is followed. They are most prolific, however, in a deep, fertile clay and give poorest yields in light, sandy soils. Some varieties make good yields when grown in heavy sandy loams. Other varieties yield very well in the heaviest clays where the ridges are sufficiently high to enable

the plant to develop a good root system. Compacted and wet soil hinders the growth of the plant and prevent norma l root development. Where ridge planting is practised the roots make a normal growth above the zone of wet soil.

In all frost-free countries yams may be planted at any time of the year, though not always profitably in a long rainy season, nor where there is a protracted drought such as sometimes occurs in Porto Rico and other Islands of the West Indies. During the season of rains the heavy wet soil tends to hasten any decay that has started in the seed yams, and too frequent rains retard and stunt the growth of the young plants. On the other hand, a long dry season, if it is followed by drought, is even more detrimental to them. Young plants set out in the dry season may not obtain sufficient nutriment to continue growth after the supply in the seed tuber is consumed. The best time to plant in western and southern Porto Rico, and probably through this island, is after the usual winter drought—that is, from late February to April—when the soil has been left in good condition for planting by the spring rains. Normal growth is then assured. Fall plantings should be made after the time of most frequent rains, but while they are still sufficiently abundant to cause a thrifty growth of the young plants. This particular period is during the last of November in Mayaguez, where the seasons are well defined.

The crop which is planted in the spring matures late in the fall and winter, and may be left in the ground during the dry winter without fear of deterioration. This crop is available for table use through a long period or for disposal at a satisfactory price, depending upon the demands of the local market. Yams intended for the succeeding crop may be left in the soil until planting time the following spring. In this way good seed may be preserved from decay. Clean seed is an important factor in establishing a good stand of new plants. Should a drought follow planting, the root sections, if they ar

free from decay, will remain in good condition for many weeds, owing to the thick corky covering of the yam which enables the seed pieces to retain for a long time sufficient moisture for the growth of the plant.

The yam, though very resistant to severe drought, requires a heavy rainfall for its best production. The plant does not have an extensive root system, nor roots that work deep into the earth, yet it secures sufficient moisture to carry it through long rainless periods. This is observed along the southern and western parts of Porto Rico, where the vines make a moderate growth and show no effect from a drought which injures other vegetation.

In preparing the land for planting care should be taken to bring the soil into good mechanical condition. Substantial ridges or hills should be made to protect against excessive soil moisture and to secure good aeration of the soil. An excess of water in the soil invariably results in a crop of poorly developed roots. The deep-rooted varieties when grown in heavy unloosened soil are rather angular and irregular in shape, and the production is small.

To avoid such results, ridges of loose earth and vegetable matter should be constructed from 1 to 1½ feet high, depending upon the locality and the subsoil drainage. These ridges should be made by plowing the land deeply and thoroughly and by opening a wide furrow over which the ridge is to be made. In this furrow a few inches of dead vegetable matter should be placed and covered with 2 or 3 inches of earth. This should be followed by another layer of vegetable matter, the layering being continued thus until the ridge is finished. As the vegetable matter decays it causes a settling of the earth. The beds should, therefore, be made a few inches higher than otherwise would be necessary for the growth of the plants.

These ridges may be cheaply constructed with a plow, the only hand labour needed being in the application of the vegetable matter and the final rounding up of the ridge with holes. The layers of manure or other vegetable

matter in the ridges insure a loose, well-aerated medium for the development of the roots, and seem to be required for their best development. The ridges do not need to be large in sand or sandy loam unless the subdrainage causes poor aeration of the strata occupied by the roots. In these soils the humus-providing material should never be omitted.

When seed is scarce, either crowns or entire small tubers may be successfully used, or a cross-section of a slender, cylindrical root may be planted. The crown or upper part of the root is the most satisfactory part for planting, because it is less desirable as food and better able to withstand exposure, bruises, or unfavourable weather longer after planting than other parts. When it is profitable to market the crop before the proper time to plant a new crop, the crowns may be left in the soil for a number of weeks after the remainder of the root has been removed. This can be done by removing from one side of the plant all the soil until the entire edible root is exposed, dividing the root at the desirable point, and removing the lower section. Care should be exercised to avoid injuring any of the feeding roots, which are spread laterally in all directions from the crown. The hole from which the earth is removed should be immediately refilled so that the plant can continue to grow and develop strong buds. Each plant has from two to four buds or eyes. The lower part of the yam has a much higher water content than the crown and consequently it is more susceptible to injury and decay than the upper part. It is also slower in starting into growth than the upper part, and should not be used unless seed yams are scarce.

The experiment station found that a good percentage of sections (taken from the largest roots) sprouted when placed in a cool, shaded place, and made a normal growth when transferred to the field. The crown and part just below usually send out from two to four sprouts promptly, and may be divided longitudinally with good results provided the piece of the root is large enough to supply nourishment for the young plant.

To secure heavy yields, seed pieces of good size should be planted. One to 2 ounce pieces are often planted in Porto Rico, but pieces weighing from 4 to 5 ounces should be used. Tests made at the station with different sized seed pieces of common varieties and with entire tubers of some of the small-rooted varieties showed that a good gain in yield was made by using large rather than small seed pieces.

Treatment of Seed Roots.

Poor stands of plants are usually caused by sections of the roots decaying before the vine growth starts. The following treatments were given a number of seed pieces to test their efficacy in preventing the entrance of decay through the cut surface of seed pieces.

The cut surfaces of one lot were covered with air-slaked lime; those of another lot were exposed to the sun for one day; two lots were treated with Bordeaux mixture, one as soon as the roots were cut and the other after drying in the sun for 10 hours. An untreated lot was placed in the storage house as soon as it was cut.

A small-rooted type of the Potato variety and a large-rooted kind of the St Vincent were used in this test. The yams were harvested 15 days before treatment, and after treatment were stored in a room having a high humidity and temperature of probably 80° F. Such conditions favour the rapid decay of the roots.

Two weeks after the treatment was applied the roots were examined. It was found that where the lime had been applied 40 per cent. of the pieces were decayed, although none of them was entirely destroyed. Where Bordeaux mixture was applied to freshly cut surfaces only 16 per cent. of the pieces showed decay, and all could be planted. The application of Bordeaux mixture to the lot that had been previously dried resulted in little improvement over the check. In the untreated lot more than three-fourths of the pieces were considerably impaired and a few were entirely consumed by disease.

while only 12 per cent. were in normal condition. In all cases a percentage of the decay on the cut surfaces developed from bruises on other parts of the roots, and in some instances from infections received after the roots were cut. The Potato variety was slightly less injured than the St. Vincent.

Distance apart to Plant.

The distance between the seed yams in planting depends much upon the normal growth of the variety. One foot apart in the ridges is sufficient for varieties producing small roots, but the larger rooted kinds require a distance of 1 to 2 feet. In Porto Rico it is the practice to plant much farther apart than this, sometimes twice the distance. This is hardly wise, because a given area will produce much more when close planting is practised. The cost will be lower, too, since the only cultivation required after planting is occasional weeding and maintaining well-formed ridges. The expense involved in cultivation consists mainly in plowing the land, securing suitable vegetable matter or manure for the ridges, building the ridges, and placing poles for the support of the vines. Any decrease in area prepared for planting results in a proportional decrease in expenses, equally good preparation being necessary for planting at any distance. Where hill planting is practised the hills should be from 3 to 4 feet apart each way, depending upon the type of soil. The wider distance is necessary in heavy soils because the hills must be made higher than in more open soil to insure good aeration and drainage. The closest planting will be f und convenient in light soils. The seed should be covered with 2 or 3 inches of earth to prevent it from drying in case drought follows, or from being washed out by heavy rains.

Tests of Vine Pruning.

To test the effect of pruning on yams, plantings were made of Guinea and Potato varieties, because they are representative of large and small rooted kinds. The ridges for planting were made in the usual way and in

soil that was well adapted to the crop. The plants made thrifty growth and were pruned back each week, the Guinea to 6 feet and the Potato variety in one plat to 2 feet, in another to 4 feet, in a third to 6 feet. Plats of each variety were left unpruned for checks. The vines of the Potato variety continued thrifty through the season, but the pruned vines of the Guinea variety lost some of their rich colour before fall and became dry several weeks earlier than the check plant. The harvest from the pruned plants of the variety Guinea was only 46 per cent. of the yield obtained from the check plat. The yield from the potato variety was 29 per cent. from the vines pruned to 2 feet, and 46 per cent. from those pruned to 4 feet, while the yield from plants pruned to 6 feet was 68 per cent. of that obtained from the check plat.

This clearly shows that the vines should not be pruned or injured if the best results are expected. Where the vine supports were insufficient or allowed to blow over and were not promptly replaced, there was a marked decrease from the normal yield. Vines not provided with supports, but allowed to creep over the ground, made very poor growth and give low yields of roots.

Harvesting.

Such implements as mattocks, heavy forks, and spades are required for harvesting yams, because the earth must be removed to the depth of the roots. The large roots fit firmly in the soil and it requires great care to remove them without injuring them. They will be bruised if pulled or pried out before the soil around them is well loosened or removed. The process of digging deep-rooted types in heavy soils is difficult in dry weather, because the roots are often enlarged near the lower end and are easily injured during removal from the hard soil. Roots of all varieties of yams are subject to rapid decay if they are bruised or the skin is broken. When bruised to any depth they soon become unfit for use. The yam,

like the potato, is used while it is fresh, and every precaution should be taken to keep it from decaying, so that the entire crop can be utilized.—*Bulletin No.* 27. *Porto Rico Agricultural Experiment Station.*

TANNING SKINS.

Goat skins make beautiful rugs, and the tanning is not nearly so complicated a process as one would imagine. First, make a strong lather with hot water and soap; let it be cold and then wash the skin in it, carefully squeezing out all the dirt from the wool; after which wash it in cold water until all the soap is rinsed out, changing the water until the last one is clear. Then put the skin in a tub and pour over it two gallons of hot water in which has been dissolved a pound each of salt and alum. See that the skin is completely covered, and let it soak for twelve hours. Drain it well then, and stretch it carefully on a board to dry, stretching it several times while drying. Before it is quite dry sprinkle on the flesh side a mixture of one ounce each of finely pulverized alum and saltpeter, rubbing it in well. Let the skin remain a day or two, and if the hair does not seem to be firm, rub again with alum; fold the flesh side together and hang in the shade two or three days, turning over each day until dry. Then scrape the flesh side thoroughly with a blunt knife and rub with pumice-stone until it is clean, and the skin will be ready for use.—*Journal of the Jamaica Agricultural Society.*

DEMERARA-BERBICE SAVANNAHS.

(*Extracts from Robert H. Schomburgk's "British Guiana 1840."*)

The sand-hills are followed by savannahs, which generally extend to the first rocky belt, and are sometimes interspersed with woods and rivulets. They are most extensive between the rivers Demerara and Berbice; they are also frequent between the latter river and the Coren

type; but these must not be confused with those of the Rupununi, which are sterile. The former are clothed with nutritious and wholesome grasses, and in consequence of the number of springs and brooks, and the thickets of wood with which they are interspersed, it appears as if Nature herself had pointed them out for the pasture-ground of thousands of cattle and horses. Those between the rivers Berbice and Demerara occupy upwards of three thousand square miles, and the favourable circumstance that they are plentifully watered by tributaries of the Demerara and Berbice, and interrupted by woodland to afford shade during the heat of the day, enhances their value as grazing-grounds.

I alluded in former remarks to the fitness of the extensive savannahs between the rivers Berbice and Demerara, for grazing-grounds, and that they are much superior for that purpose to those of the Rupununi. The climate in these regions is uncommonly healthy, and the country so well watered by springs and rivulets, that the great want of water which exists in the savannahs of the Rupununi, and which is such an obstacle that I fear they will never be inhabited by Europeans or their offspring, is here entirely set aside. If, therefore, enterprising colonists should cultivate pasturing-grounds, and stock them with cattle from the savannahs of the Rio Branco, fresh beef might be had at an equally cheap rate as in the United States: it will then be in the power of the peasantry of British Guiana to provide themselves with fresh meat at a price which bears a relative value to their wages.

AGRICULTURE *Versus* MALARIA.

BY E. P. MINETT, M.D., D.P.H., D.T.M. AND H., Government Medical Officer of Health.

A perusal of the reports of the various anti-malarial commissions established in various parts of the world throws much light on the great part played by the agriculturist in the fight against malaria. The well known "Bund" system used by Bentley in India is an example of what can be done to reduce malaria by means of properly controlled and applied agricultural methods of fighting the mosquito. The "bund" system consists in converting low-lying portions of land into ridges or beds somewhat in the same way as is done on sugar estates, but the beds are wider; the high beds are then used for cultivation and the water remaining in the channels between is kept comparatively free from mosquito larvae simply by keeping the channels free from vegetation and by strict attention to the edges. The mosquito larvae being thus deprived of shelter are left to be dealt with by their natural enemies. It is a well known fact that mosquito larvae are very difficult to find in ponds, trenches or streams where no vegetation exists. In Salonika it is remarkable that the small streams are free from vegetation and larvae very difficult to find except at one portion of the year during the spring, when they are overgrown with a small filimentous aquatic plant called "spirogyra." This plant appears at the beginning of the mosquito season and is the natural food of the larvae. In streams where this vegetable growth was systematically removed, larvae were very rarely detected and adult mosquitoes uncommon after the bushes which form their natural shelter had been removed.

Much controversy has arisen over rice cultivation and interesting articles have been written in the "Rice Journal" and "Southern Farmer" in America. A large number of investigations were carried out and it was

found that some rice fields do not produce anopheles at all, whilst other rice fields produce them in moderate or large numbers, but seepage and drainage water incident to rice culture largely increase these numbers. This is borne out by our own investigations in this colony, as I think it is generally admitted that, although anopheles mosquitoes are undoubtedly found in rice fields, still they are much more abundant in the drainage canals and swamps surrounding the rice fields than in the fields themselves. This is what would be expected as the mosquito larvae do not thrive in the open clear water of the rice fields because they have no shelter from their natural enemies.

The writer has always held that undoubtedly rice cultivation is not a healthy one from a malaria point of view, still rice fields are preferable from a health point of view to stagnant swamps, borrow pits and overgrown neglected drainage trenches,—firstly, because rice fields are far less suitable breeding places for mosquitoes, and secondly, because rice fields are valuable from an economic and food standpoint and they mean an abundant supply of the staple diet of the labouring classes. Whereas swamps, &c., are much more suitable breeding places and are of no economic value whatever.

The preliminary report of the Anti-Malarial Commission in Egypt states: "The largest breeding places such as marshes, borrow pits and birkas (ponds) can only be dealt with by filling them in." To attempt to fill in the vast areas of marshy land in British Guiana is a hopeless task, but this land could be more widely taken up for rice cultivation and after a few years other crops can be substituted when the drainage has been improved and the surface gradually raised by successive rice crops.

The Egyptian report states: "Rice, it is understood, cannot be grown under conditions that will not produce mosquitoes. It is, however, a crop that is generally grown on land unsuitable for other cultivation, and in Egypt,

when the rice fields have been properly drained, it will to a great extent yield automatically to more valuable crop such as cotton."

If swamps and land unsuitable for cultivation can be made suitable by means of rice cultivation as preliminary crops in Egypt, I see no reason why it cannot be carried out successfully here.

In some parts of the world where rice is grown largely, very great attention is paid to the drainage and irrigation canals as being more important from a malaria point of view than the rice fields themselves. The banks of the larger channels and the whole bed of the smaller drains are sprayed with crude petroleum oil; they are then lightly sprayed with petrol or refined petroleum and fired at once. This treatment has been found very efficient in preventing mosquito breeding in Trinidad. It has occasionally been used here on a small scale, but not on a large enough scale, owing to the expense to prove its efficiency. Every village lot proprietor can become an anti-malaria enthusiast on a small scale with very little trouble and very great benefit to his own and his family's health.

Low-lying swampy ground can be raised and converted into valuable cultivation land by the very simple process of digging out a few inches of the low-lying swampy patch of land. Then fill in the hollow with house and garden refuse until it reaches above the level of the surrounding land, finally spread the earth originally excavated evenly over the surface of the rubbish. In a few weeks it will settle down and provide a most valuable provision bed where previously only a dangerous mosquito breeding swamp existed.

The above is a piece of practical hygiene which might very well be carried out by school children in the school yard as an agricultural lesson.

Malaria disappears before good agriculture and sanitation.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the first nine months of 1921. The corresponding figures for the two previous and the average for the four years previous to that are added for convenience of comparison.

Product.	*Average 1915-18.*	*1919.*	*1920.*	*1921.*
Sugar, tons ...	63,382	43,583	48,442	59,283
Rum, gallons ...	2,705,790	3,438,593	1,183,175	1,799,349
Molasses, gallons ...	28,831	171,247	100	204
Cattle-food (Molascuit tons)	1,394	1,112	953	1,055
Cacao, cwts. ...	224	85	207	None
Citrate of Lime, cwts.	165	306	206	286
Lime Juice, gals. ...	8,286	6,663	2,641	3,850
Essential Oil of Limes, gals.	149	291	236	463
Coconuts, thousands	1,255	3,040	2,139	1,999
Copra, cwts. ...	1,575	1,602	296	654
Coffee, cwts. ...	2,702	7,933	3,554	684
Kola-nuts, cwts. ...	12	None	9	None
Rice, tons ...	9,498	3,158	8,084	1,095
Ricemeal, tons ...	172	None	None	None
Cattle, head ...	498	1	4	None
Hides, No. ...	2,547	5,369	5,166	11,615
Pigs, No. ...	558	None	None	47
Sheep, head ...	15	None	66	26
Balata, cwts. ...	6,672	4,999	7,740	4,290
Charcoal, bags ...	37,449	33,020	35,749	39,174
Firewood, Wallaba, etc., tons ...	6,563	5,939	3,977	4,684
Gums, lbs. ...	264	2,001	3,361	8,792
Lumber, cub. ft. ...	157,969	179,237	207,476	141,038
Railway sleepers, No.	10,476	2,008	10,707	5,512
Rubber, cwts. ...	91	79	134	14
Shingles, thousands	1,840	1,932	1,722	1,616
Timber, cub. ft. ...	63,839	98,303	57,088	114,413
Coconut Oil, gals. ...	18,545	6,371	12,176	11,326

ATTENDANCES AT THE DISTRICT GARDENS

Year.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,200
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,886
1918 ...	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919 ...	4,769	2,425	1,582	2,798	1,851	2,480	1,556	17,461
1920 ...	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921 ...								
1st Quarter	1,761	639	502	307	673	829	490	5,201
2nd Quarter	1,790	554	410	1,408	549	812	430	5,993
3rd Quarter	1,210	289	350	405	315	499	306	3,374

Meteorological Data—July to September, 1921.

1920 Months	Rain-fall. Inches.	NUMBER OF DAYS OF RAIN: Under ·10 Inches.	·10 to ·50 Inches	·50 to 1.00 Inch	1.00 to 2.00 Inches	Above 2.00 Inches	Total days.	Evapo-ration. Inches	Air Temperature and Humidity. Air Temp. Maximum	Minimum.	Mean	Humidity.
Botanic Gardens.												
July ...	12.73	3	11	2	7	...	23	4.15	84.7	74.0	79.3	82.6
August	3.52	7	6	2	...	...	15	5.44	86.0	75.6	80.8	78.3
Sept. ...	3.42	5	7	2	...	...	14	5.02	86.8	76.1	81.4	79.8
Totals & Means.	19.67	15	24	6	7	...	52	14.61	85.8	75.2	80.5	80.2
Berbice Gardens.												
July ...	11.71	1	8	6	4	...	19	...	85.3	75.2	80.2	82.8
August	5.34	...	10	2	1	...	13	...	85.9	75.5	80.7	74.8
Sept. ...	3.34	1	6	1	1	...	9	...	87.6	76.0	81.8	80.3
Totals & Means.	20.39	2	24	9	6	...	41	...	86.2	75.5	80 9	79.3
Suddie.												
July ...	11.05	1	7	6	4	...	18			87.9	72.8	80.3
August	6.10	5	2	3	2	...	12			87.8	72.7	80.2
Sept. ...	4.15	2	8	1	1	...	12			87.8	72.7	80.2
Totals & Means.	21.30	8	17	10	7	...	42			87.8	72.7	80.2
Mora-whanna												
July ...	18.73	1	7	5	4	3	20	...	...	...	...	...
August	13.49	7	8	4	4	1	24	...	...	...	...	...
Sept. ...	16.29	3	2	4	4	3	16	...	...	...	...	...
Totals ...	48.51	11	17	13	12	7	60	...	...	...	...	...

OTICE TO AGRICULTURISTS.

POST OFFICE SAVINGS BANK.

A cash balance is a hall mark of the good farmer; it also an essential of progress. It means, also, independence; for a well established balance in the Savings Bank does away with the discomforts and dangers of obtaining credit in order to plant and reap one's crops and, later, the attendant evil of being compelled to sell the produce at a disadvantage. Remember that no profits are made by the Government on the moneys deposited in the Post Office Savings Bank as this Bank is intended solely as an aid in the practice of economy and thrift also—

Deposits are absolutely safe.

Any person may open an account.

A married woman may deposit in her own name.

A minor at the age of 4 may do so also.

Interest is paid on deposits up to $2,500 The rate of interest at present is 3 pe cent.

A depositor may withdraw or deposit mone at any Post Office.

AGRICULTURAL COLLEGE AND R...
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26 MAY 1936